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ABSTRACT

A study was undertaken to improve the measurement of small team performance within the Army. A provisional taxonomy of team-level performance functions was field-validated; criteria and measures of the functions were developed; and their reliability was examined. The provisional taxonomy, used for observing Army field training exercises, was used to observe three types of Army teams: mortar squads, infantry squads, and assault ribbon bridge platoons. The taxonomy was then revised to include five functions: orientation; resource distribution (load balancing); timing (activity pacing); response coordination; and motivational functions. The first four of these functions were observed in a small-scale laboratory setting in which briefly trained subjects rated 15 videotaped segments of team activity. The ratings were generally reliable, although there was some acquiescence bias leading raters to rate functions as present when they were not. The experimental materials, including the Team Function Rating Scales, are appended. (GDC)

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Research Report 1397

ED264311

The Definition and Measurement of Small Military Unit Team Functions

Samuel Shiflett, Ellen J. Eisner,
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This report examines the adequacy and applicability of a provisional taxonomy of team functions for describing team level (vs. individual) performance in Army field settings. The main product of the research was a revised taxonomy representing the first attempt at operationally defining team functions and constructs based on observations of actual Army teams performing routine training exercises. The report describes efforts to modify and validate the taxonomy as well as a laboratory study in which

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subjects used specifically designed rating scales to rate the extent to which team functions were present in videotaped segments of teamwork.

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FOREWORD

This team function report is part of a broader program on training for combat effectiveness being conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). The ARI Field Unit at Fort Benning, Georgia, has been conducting a team research program whose long-term goals are to improve the training and assessment procedures of small military units.

The report focuses on defining and measuring team functions--dimensions of performance that distinguish teams from individuals and reflect the type of team member interactions required to complete a task or mission. A validated taxonomy of team functions is described as well as a procedure for measuring the functions based on videotapes of military team activities.

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Technical Director

ACKNOWLEDGMENTS

The team function project was initiated by Ms. Dorothy Finley of the ARI Fort Benning Field Unit. She served as contract monitor throughout most of the project; Dr. Jean Dyer was contract monitor during the project's final phases. The authors appreciate the contributions and guidance made by these two individuals to the study, and their continuing involvement in ARRO's attempt to resolve theoretical and measurement issues in the team functions arena.

THE DEFINITION AND MEASUREMENT OF SMALL MILITARY UNIT TEAM FUNCTIONS

EXECUTIVE SUMMARY

Requirement:

Improvement of small-unit performance within the Army depends, in part, on the ability of trainers to assess unit progress in terms of progress and product measures. At present, few schemes exist for measuring processes; what is typically called "teamwork." The report describes an effort to fill this methodological gap. The research included field validation of a provisional taxonomy of team-level performance functions, development of definitions and measures of the functions, and an examination of the reliability of the function measures.

Procedure:

Several preliminary measurement and recording instruments were developed to test the adequacy and useability of the provisional taxonomy developed by Nieva, Fleishman, and Rieck (1978) for observing Army field training exercises. Three types of Army teams (mortar squads, infantry squads, and assault ribbon bridge platoons) were observed using these instruments. Difficulties in identifying the functions and distinguishing among them led to a reorganization and refinement of the taxonomy into five broad categories of functions--Orientation, Resource Distribution, Timing (Activity Pacing), Response Coordination and Motivational Functions. Using four of these functions, a small-scale laboratory study was conducted in which subjects attempted, after a brief training period, to identify functions in videotaped segments of team activity and to rate various dimensions of the functions on specially designed rating scales.

Findings:

The results of the laboratory study provided evidence that naive subjects, after a relatively brief training period, could make consistent decisions regarding the presence of taxonomic functions in videotaped Army field training exercises. The subjects also were able to reliably rate the tape segments on 14 behaviorally anchored rating scales corresponding to various dimensions of the taxonomic structure. The data indicated that at least some of the raters had an acquiescence bias leading them to rate functions as present when, in fact, they were not. Difficulties encountered in applying the taxonomic structure in the field and in the laboratory indicated several ways in which future research efforts can improve upon the current taxonomy and associated measurement instruments.

Utilization of Findings:

Results of this project indicate that, with further development, the revised taxonomy and measurement scales can be used in actual Army field settings to examine the relationship between team functions and observable criteria of team effectiveness. Further research in this direction holds promise for elucidating the numerous problems of team effectiveness including how to measure and describe team performance, how to develop and train teams, how to predict good and poor team performance, and how to design teams to optimize their performance.

THE DEFINITION AND MEASUREMENT OF SMALL MILITARY UNIT TEAM FUNCTIONS

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THE DEFINITION AND MEASUREMENT OF SMALL MILITARY UNIT TEAM FUNCTIONS

CHAPTER 1

INTRODUCTION

Although there is much research and theory with regard to training team members in the individual skills necessary to achieve team goals and missions, little research or theory exists on the training of those behaviors which bring individual skills and talents together into a smoothly integrated unit or team. These behaviors, or team functions, are essential to understanding group performance and enhancing group effectiveness. Without team-related functions, people and their associated skills are nothing more than aggregations, each performing his separate tasks. When these functions are present, these small aggregations become unified teams, potentially operating as efficiently as any smoothly running machine composed of different but functionally related parts.

It is well known that the military--and particularly the Army--is made up of thousands of small teams whose effectiveness, and sometimes, whose very survival is dependent upon the ability of the individual team members to organize their personal resources into a unified whole. In recent years, a lack of this ability to function effectively as a team, and a lack of training in these team-related functions has been recognized by Army leaders as a serious inadequacy in current military training programs.

As a preliminary step to addressing the problems of team performance and effectiveness, ARRO, under contract to the Army Research Institute, investigated the nature of team performance and the factors affecting it, and developed a provisional working taxonomy of team functions. That project resulted in a report by Nieva, Fleishman, and Rieck (1978) entitled, "Team Dimensions: Their Identity, Their Measurement, and Their Relationships."

In that report a functional approach to defining the domain of team performance was taken. A team was defined as two or more interdependent individuals performing coordinated tasks toward the achievement of specific task goals. In addition, a team was characterized as having a task orientation shared by all team members, as well as a condition of task interdependence. Team performance functions, on the other hand, specified what a team did in the interactive effort to accomplish its work. These team functions described the operations of the team as an entity in terms of the purpose or outcome of the operations, rather than in terms of the specific behaviors or skills of individual team members.

The four classes of functions contained in the provisional functional taxonomy--Team Orientation Functions, Team Organizational Functions, Team Adaptation Functions, and Team Motivational Functions--were meant to supplement individual performance dimensions which describe the activities of individuals within the team. Since team performance rests on individuals carrying out specific subtasks as well as on the coordination and interaction of such individual activities, any effort to improve team effectiveness must include both levels of analysis--team and individual. An adequate taxonomy of team functions was seen as potentially useful for studying the numerous problems of team effectiveness--for example, how to measure and describe team performance, how to develop and train teams, how to predict good and poor team performance, and how to design teams to optimize team performance.

The present effort extended the initial work of Nieva, et al. (1978) by revising and validating the taxonomy and developing preliminary measures of the functions. In particular, the following issues were addressed:

- o Was the provisional taxonomy developed by Nieva, Fleishman, and Rieck (1978) adequate for describing team performance?
- o Could the team performance functions contained in the provisional taxonomy be applied in real military settings? If not, could the taxonomy be improved?
- o Was the taxonomy valid in terms of its comprehensiveness and its ability to capture the essence of what was happening in a team during routine military missions?
- o Would it be possible to develop some reliable instruments to measure the team functions in various military settings?

This report summarizes the work done to answer these basic questions. The main product is a revised taxonomy which represents the first attempts at operationally defining various team functions and constructs based on actual observation of Army teams performing routine training exercises. The report describes the efforts to modify and validate the taxonomy, and culminates in a detailed discussion of the taxonomy in its revised form. This taxonomy was used to design a controlled laboratory study in which specially developed observational instruments for identifying the presence of team functions in actual Army settings were pilot tested.

The outline of the report is as follows. Chapter 2 briefly discusses the original taxonomy as presented by Nieva, et al. (1978). Chapter 3 provides a description of the teams and settings involved in developing the early measurement instruments and in obtaining videotapes of the activities under observation. Chapter 4 presents the results of the field observation in terms of the problems encountered in using the early measurement instruments and the issues raised with regard to improving the provisional taxonomy. In Chapter 5, the revised taxonomy is presented along with the rationale for the changes made. Chapter 6 describes the development of psychometric scales to measure the functions and a laboratory study designed to determine whether people can detect functions in real-life team settings. A complete set of the scales, plus extensive supporting documentation is provided in the Appendix. Chapter 7 discusses future research directions, strategies, and issues which are relevant to the continuing development of the taxonomy and its related scales.

CHAPTER 2

THE PROVISIONAL TAXONOMY OF TEAM FUNCTIONS

The primary goal of this project was the development of a valid and operationally defined taxonomy of team functions. Validation, in terms of this report, refers to the attempt to use the provisional taxonomy of team functions developed by Nieva, Fleishman, and Rieck (1978) in real team-task settings in order to determine the adequacy and completeness of that taxonomy for describing team activities. Based on this practical application of the provisional taxonomy, a revised and improved taxonomy was developed.

The goal of the initial provisional taxonomy was to define the domain of team performance by focusing on performance dimensions that make effective, synchronized teamwork possible. The hope was to avoid undesirable extremes in scope or generality since excessive specificity in a classification system precludes efforts at generalization, while a schema of inordinate generality never progresses beyond the conceptual stage of development. The aim was for a system broad enough to be relevant to a number of different team performance situations, while remaining sufficiently specific for the distinctions made to be meaningful.

An implicit assumption in developing the taxonomy was that certain common dimensions underlie many apparently diverse team performance settings. These dimensions are exhibited in varying degrees depending on task requirements as well as team proficiencies. A second assumption was that team performance dimensions specific to the team task context might also exist and would supplement the general dimensions proposed. In sum, the taxonomy was designed to be a middle-level system which provided a common metric for team performance situations, but which might require supplementary information when considering specific situations.

Based on Nieva, et al.'s (1978) review of the literature on team training and group processes, a functional approach to defining the domain of team performance was proposed with the following four major categories of team performance functions.

- Team Orientation Functions
- Team Organizational Functions
- Team Adaptation Functions
- Team Motivational Functions

These functions had a number of characteristics. First, they focused directly on task accomplishment which resulted from the interconnections among team members. Second, they were relatively molar in character, and were presumed to cut across specific activities occurring in the team. A corollary to this was that there was no one-to-one relationship between specific activities and the team functions; that is, an activity could serve several different functions at one time. Third, the measures of team functions reflected relative, rather than nominal, scales, so that teams could be ordered with respect to each other on the functions.

The provisional team performance functions are described below in greater detail, along with dimensions within each category.

Team Orientation Functions involved the processes by which information necessary to task accomplishment is generated and distributed to relevant team members. Such information included that internal to the team (i.e., team member resources and requirements), in addition to information about the environment's resources and demands. This function reflected the development of system awareness, of an integrated model of the environment, and of team awareness. In other words, it involved an orientation to or an awareness of the occurrence and importance of various events and conditions both internal and external to the team.

Among the dimensions proposed to be relevant to this category were:

- Generation and distribution of relevant information about team goals and missions, including the relative importance of these goals.
- Generation and distribution of information about member resources (e.g., abilities, information, training), and consequently, about their possible constraints.
- Generation and distribution of information about situational resources and constraints.

Team Organizational Functions involved the processes necessary for the group members to perform their tasks in coordination. They included the processes by which the team members decide who is to do what and when; the development of patterns or "programs" of coordinated behavior in response to the task environment. These functions depend on the effectiveness with which the demand resources have been clarified and demand a certain level of awareness among team members of task demands, member resources, and situational resources.

The dimensions proposed in this category were:

- Matching member resources to task requirements, or what is typically referred to as "division of labor."

- Response coordination and sequencing of activities, such that team member activities flow smoothly and do not interfere with each other.

- Activity pacing, which is highly related to response coordination.

- Priority assignment among subtasks.

- Load balancing of tasks by members.

Team Adaptation Functions included the processes which occur as team members carry out accepted strategies, make mutual adjustments, and complement each other in accomplishing the team task. The capacity for mutually complementing performances is one of the major advantages of teamwork over work by individuals. This category encompassed what has been generally referred to as "cooperation."

The dimensions proposed as relevant to this category were:

- Mutual critical evaluation and correction of error, which included opportunities for team members to view each other's performance, the presence of sufficient common ground to enable detection of error, and a sufficiently open climate to allow for the discussion and admission of error.

- Mutual compensatory performance, which included processes by which team members perform tasks not typically defined as their responsibility. These compensatory performances tend to be called for in emergency situations (e.g., temporary overload on some members, equipment failure).

- Mutual compensatory timing, which included processes by which team members informally adjust the time involved in carrying out specific subtasks, so that the overall task is accomplished in an effective and timely manner.

Team Motivational Functions are processes that define team objectives related to the task, and energize the group towards these objectives. They determine the intensity with which team members invest their energy and expectations on behalf of the group. Stogdill (1972), in his review of research on group productivity, shows group drive to be an essential dimension of group performance. Team Motivational Functions also encompass what has been generally called "task-orientation" (Bales, 1951), which, in turn, leads to higher team effort and energy.

The relevant dimensions proposed in this category were:

- Development of team norms regarding acceptable levels of performance.

- Generating acceptance of team performance norms.

- Establishing performance-reward linkages for the team as an entity.

- Reinforcement of task orientation, which includes informal rewards, as well as sanctions for ineffective performance.

- Balancing overall team orientation with individual competitive orientations in the team.

- Resolution of informational, procedural, and interpersonal conflicts which interfere with task orientation.

Table 1 presents a summary of the four major team performance functions and the performance dimensions within each function. This table represents the initial taxonomy of team performance functions proposed by Nieva, Fleishman, and Rieck (1978).

TABLE 1

Original Taxonomy of Team Performance Functions*

I. Team Orientation Functions
    A. Elicitation and Distribution of Information about Team Goals
    B. Elicitation and Distribution of Information about Team Tasks
    C. Elicitation and Distribution of Information about Member Resources and Constraints
    D. Elicitation and Distribution of Situational Resources and Constraints

II. Team Organizational Functions
    A. Matching Member Resources to Task Requirements
    B. Response Coordination and Sequencing of Activities
    C. Activity Pacing
    D. Priority Assignment Among Tasks
    E. Load Balancing of Tasks by Members

III. Team Adaptation Functions
    A. Mutual Critical Evaluation and Correction of Error
    B. Mutual Compensatory Performance
    C. Mutual Compensatory Timing

IV. Team Motivational Functions
    A. Development of Team Performance Norms
    B. Generating Acceptance of Team Performance Norms
    C. Establishing Team-Level Performance-Rewards Linkages
    D. Reinforcement of Task Orientation
    E. Balancing Team Orientation with Individual Competition
    F. Resolution of Performance-Relevant Conflicts

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*From Nieva, Fleishman, & Rieck, 1978.

CHAPTER 3

OBSERVATIONAL PROCEDURES AND SETTINGS

In order to test the applicability of the provisional taxonomy described in the previous chapter, validation efforts were conducted with several different Army teams. These teams were: infantry rifle squads and platoons; combat engineer assault ribbon bridge platoons; and mortar squads (both 4.2 in. and 81 mm.). These teams were observed at various times during a six-month period in order to maximize variance in team and task characteristics.

Because of availability constraints determined primarily by Army field training exercise (FTX) schedules and geographical restrictions, the different teams and tasks were observed for widely differing amounts of time. For example, the bridge team was observed only once for a total of four hours, since most teams of this type are located overseas and are largely unavailable for observation in the U.S. Infantry rifle squad activities, in particular the hasty defense exercise, were observed a number of times since this exercise was conducted weekly over a three-month period at an installation in the local area. The hasty defense exercise was observed most often since it also facilitated an additional project requirement that selected team activities be videotaped.

Data collection involved videotaping team activities and recording verbal and nonverbal communication among team members, as well as physical positioning and movements during the FTXs. Some brief unstructured interviews with team members and command personnel were conducted to obtain background information on factors such as team stability (length of time together as a unit), previous combat training, less visible member-task assignment processes, and relevant characteristics specific to the unit or installation.

During the FTXs, a non-participant observation method was used to obtain data. Two or three project staff members were involved in each site visit. The observers made every attempt to keep a low profile and to interfere as little as possible with the training and field exercises.

Pre-Visit Activities

Prior to the site visits, project staff reviewed Army documentation, including field manuals (FMs), training circulars (TCs), Army training and evaluation programs (ARTEPs), and other literature describing the teams, their mission, job tasks, standing operating procedures (SOPs), and equipment. Scripts providing information about team structure, activities, behaviors as possible indicators of team functions, and external/environmental variables were then prepared to guide videotaping and data collection efforts. From these scripts a list of "team tasks" (i.e., those involving the interrelated efforts of two or more team members) were identified as behaviors to look for during observation.

The collection of information in the scripts was quite broad, in an attempt to develop a scenario covering a wide range of possible team arrangements, activities, and settings.

Videotaping

As mentioned, part of the research project required that team activities reflecting different team functions described in the taxonomy be videotaped. These tapes were used in the second phase of the project during which a final laboratory-type validation of the team functions was conducted.

As expected, videotaping had a number of effects on the teams observed. While the use of videotaping equipment limited the ability of project staff to be unobtrusive, this obtrusiveness in most cases was seen by command personnel to be a positive factor. In fact, the presence of the recording equipment seemed to enhance motivational and evaluation apprehension factors. The idea of being filmed apparently served as a positive incentive for most crews accustomed to performing exercises in relatively boring and unrewarding circumstances.

In several instances, crews offered to do whatever project staff requested, including substantial alteration of originally scheduled training exercises. Although project staff at first declined to interfere with already planned training, they eventually permitted certain alterations (usually repetitions of already planned exercises) where it appeared not to interfere with training and represented additional repetitions of already scheduled exercises. It was apparent on several occasions that an exercise which had not gone well was repeated so that the crews would be able to have a "good" performance on tape, instead of an example of poor performance. These occurrences clearly demonstrated the positive motivational character of the videotaping activities.

A brief description of the types of teams videotaped and their missions is presented below.

Team Characteristics and Activities

Three types of Army teams were observed and videotaped--infantry rifle squads and platoons, a combat engineer assault ribbon bridge platoon, and mortar squads.

Infantry Rifle Squad

The infantry rifle squad is charged with performing a variety of combat missions, including movement-to-contact/meeting engagement, hasty defense, reconnaissance patrol, and forced march/live fire exercises. The squad is characterized by its flexibility for deployment over any type of terrain. Effective use of cover, concealment, camouflage, and fire power is the method of operation prescribed for these units. The squads observed by project staff operated dismounted and were not supported by other combat arms elements such as mortar squads, armor, or artillery. Squad members were equipped with M16 rifles, an M60 machinegun, grenades, and claymore mines.

When compared with other types of teams, infantry rifle squads operate within a more emergent or less structured and predictable task environment. As such, there is a wide diversity in missions, tasks, and functions performed. For example, rifle squads were separately observed in the roles of assault and defense. Often unknown external and spontaneously occurring variables, such as the size of the opposing force (OPFOR), type of terrain, number of casualties inflicted, and time and place of engagement, alter the demands placed on members of the squad, even as the "task" is occurring.

Most of the data collection efforts focused on infantry rifle squads conducting hasty defense operations. The hasty defense is most often conducted by first-echelon units in an offensive action when their advance has been stopped. These units then move onto the nearest defensible terrain and establish defensive positions. Several movement-to-contact exercises were also observed. During these activities, data primarily reflecting verbal exchanges and resource distribution of the assault unit were obtained.

The exercises began with the operation order immediately followed by a 15-minute period during which squad member defensive positions were established, a listening post/observation post (LP/OP) was dispatched, and two claymore mines were placed. The pre-engagement phase entailed building bunkers (which were already partially constructed), fixing camouflage, planning, and distributing instructions prior to engagement. Specific tasks and the manner in which they were performed (e.g., whether or not the operation order was given to all squad members or to fire team leaders only) varied with each squad.

The MILES (multiple integrated laser engagement simulation) equipment was used in some of the training exercises. They system involves the use of laser devices attached to rifles and sensor devices worn by the soldiers. These devices indicate when an individual has been "hit." When compared with traditional training technologies, the MILES system contributes considerably to the realism of the exercise.

Combat Engineer Assault Ribbon Bridge Platoon

The assault ribbon bridge platoon is charged with the general training mission of conducting an assault ribbon bridge rafting operation in a tactical manner. The bridge platoon consists of two sections: an assembly section and a transporter section. The assembly section is charged with the assembly and disassembly of the bridge bays into a raft or bridge. In the platoon observed, this section was staffed with a section sergeant, nine boat operators, and three bridge specialists. The transporter section is responsible for the transport of the boats and bridge components, and for the launching and retrieving of equipment. The platoon observed had three boat transporter operators and five bay transporter operators, which accounted for about one-third of the platoon personnel (transporter operators and section sergeant). The specific exercise observed involved the assembly of a five-bay raft. Each bay or section of the ribbon bridge is designed such that it can be transported on a three-axle truck or transporter. The length of the central bays is approximately 20 feet, thus requiring a large-scale operation involving large, heavy equipment. Each bay is transported to the river site independently, launched into the water, and assembled and connected to the raft. A five-bay raft consists of three interior bays and two ramp bays, one at each end.

The first stage of the assembly process observed was the launching of the three erection boats. Two boats were used for maneuvering the raft sections for assembly, while the third served as a safety boat stationed downstream during the entire operation. Following the boat launching, two interior bays were launched using the free launch method. Each assembly erection boat was lashed to one of the bays, and then both bays were maneuvered toward the center of the river and guided together by the boat operators. When the bays were properly positioned, the assembly crews connected the bays. One boat remained lashed to the two-bay base unit, while the other returned to the shoreline to pick up the third internal bay which was simultaneously free launched. This third bay was maneuvered to the two-bay unit and connected. A similar procedure was followed for each of the two end bays. Following raft assembly, the erection boats were attached to the completed raft in order to ferry several trucks across the river.

The last phase of the operation observed was the bridge disassembly. Generally, this process is the reverse of assembly; however, a potentially important difference exists. During assembly the critical team functions seem to stem primarily from task requirements for coordination in maneuvering the bays and sequencing/timing the bay launches to coincide with arrival of the erection boats. During disassembly, a far greater proportion of effort is spent actually loading the bays and boats onto the transporters.

Mortar Squad

The mortar squad is charged with providing indirect fire support to the infantry ground troops. Tasks include direct lay, indirect lay, firing for effect, and illumination firing. Several mortar crews were observed and videotaped--both mounted and dismounted 4.2 in. mortar crews, and dismounted 81 mm. mortar crews. A typical sequence of tasks included:

1. Setting up camouflage netting.
2. Assembling and placing the mortar into action, a task which normally requires the coordinated efforts of two (if mounted) or three (if dismounted) men to accomplish in a maximum period of 90 seconds.
3. Boresighting of the mortar, using an aiming stake.
4. Laying the mortar (dismounted only), for deflection and elevation, task which involves firing the mortar so that the recoil sets the baseplate firmly into the ground, and resighting the gun.

5. Preparing the mortar ammunition for firing, a task which involves unpacking the ammunition, selecting the correct ammunition for the firing requirement and placing the charge. For illumination firing the fuse must also be set.

6. Adjusting the deflection and elevation of the mortar, using information from the Fire Direction Center (FDC), and firing upon command. (In the case of direct lay without an FDC, two crew members calculate elevation and deflection.)

A typical mortar squad contains five positions: crew chief; gunner; assistant gunner; ammo (ammunition) bearer; and assistant ammo bearer. Most of the mortar teams observed were operating understrength and had either three or four men per crew.

CHAPTER 4

PRELIMINARY OBSERVATIONS AND ISSUES

This chapter presents a discussion of the early attempts to use the provisional taxonomy in observing the Army teams described in the preceding chapter. It also includes a discussion of several basic issues related to revising the taxonomy and developing corresponding measurement instruments. The specific limitations and difficulties noted in this chapter served as a framework for reanalyzing and improving the provisional taxonomy. While the current chapter describes the information gathered to revise the taxonomy, a discussion of the actual revisions can be found in the following chapter.

First Stage Observations and Recording Instruments

Initial attempts to use the provisional taxonomy immediately encountered obstacles. In spite of the effort to make the taxonomy neither too general nor too specific, the taxonomy, in fact, turned out to be too general, at least for use as an observational tool. Four major problems surfaced almost immediately:

1. The definitions of the proposed functions were often so incomplete that it was difficult to distinguish between dimensions both within and across functional categories.

2. It was necessary to resolve the issue of whether obviously related yet behaviorally distinct activities such as "eliciting" and "distributing" information should be seen as examples of the same function or as distinctly different functional dimensions.

3. The motivational functions provided a special problem since many of them were not readily observable in a typical task setting, and since many behaviors seemed to include a motivational component in addition to serving some other function.

4. The distinction between informational and implementation purposes was not clearly made.

In addition to these basic problems, the initial observation of team activities suggested that the bulk of team member interactions could be conceptualized in one of the four following ways:

1. Information exchanges about fellow team members and matters related to the internal functioning of the squad;

2. Information exchanges about the state of affairs with respect to the opposing force (OPFOR) or the external environment;

3. Actions or cues for action occurring in response to the state internal to the team; or

4. Actions or cues for action stimulated by characteristics of the OPFOR or external events.

These findings led to a reexamination of the provisional taxonomy in which virtually all of the functions were found to serve a broader prupose of conveying either information or physical resources. In addition, most of the processes in a function involved one of two forms of "energy"--either (a) a pure communicational/informational transaction, or (b) an action occurring as a direct result of the information. The action usually resulted in a new flow of informational energy (feedback), often occurring simultaneously with the action. Furthermore, all actions and information could be described according to whether they had one of two loci: the internal environment (the team itself), or the external environment (e.g., the enemy force).

In line with this cybernetic-like view, it was decided to approach the development of measuring instruments in such a way as to permit them to: (a) fit into a broad functional conceptualization of continuous information/action flow; (b) provide direct operationalizations of currently formulated function categories; and (c) be modifiable as the taxonomy was modified.

Problems in Observing/Identifying Team Functions

The main problem underscored by the team observations and the early attempts at recording functions was that "functions" cannot be observed directly. They must be inferred from the situation. Knowing which function has been accomplished involves knowing why something was done and what effect it had on the situation; that is, behaviors can serve a particular function as the result of deliberate planning or design, or they can serve it purely by accident. Even more importantly, many different behaviors or processes can conceivably serve the same function, depending on the context and other circumstances. Conversely, the same behavior can serve different functions at different points in time or in different situations. The same behavior can also serve more than one function simultaneously.

While the initial data collection instruments focused closely on pure behavioral events, they failed to properly reflect the context which would indicate the function being served by the observable actions. In effect, the complications associated with the early data collection became the prelude to the problems that were encountered throughout the project--that of defining the functions in terms of observable events, whether behaviors in a team context or marks on a paper-and-pencil scaling device.

Basic Issues in Using the Provisional Taxonomy

A major issue emphasized by team observation was the level at which the taxonomy should conceptualize and categorize team dimensions. That is, how broadly or narrowly should each function be defined? This problem involved distinguishing between what can be called "team-level" functions, and more specific tasks or subfunctions characteristic of nearly any open system. This problem was compounded by the fact that the terms "function," "Task," and "process" are often used interchangeably in the human engineering literature.

A separate problem which also had an impact on the focusing of functions concerned the particular goals the taxonomy would be serving. In the present study, it was clear that the taxonomy was designed to guide the development of concepts and measures of team performance for the eventual purpose of training soldiers to be more effective team members. This ostensible goal did not of itself, however, provide much guidance as to how detailed or focused the taxonomy should be, or what functions were likely to be more important and useful to the Army. The approach selected, therefore, was directed toward developing a mid-range taxonomy, one which had the capacity of being expanded or narrowed as its potential applications became clearer.

In order to avoid problems that might result from defining functions so narrowly that they would become inseparable from specific tasks, and to keep the focus on the team per se, attempts were made to define the functions in broad enough terms so that the accomplishment of the function would become a process or "behavioral episode" involving a series of qualitatively different tasks or subfunctions. For example, in most open systems a complete transaction involves the input of information and energy, the processing of the information, an action or implementation phase, and a monitoring or feedback phase which results in the action being terminated, maintained, or modified in some way.

For purposes of this study, all team-level functions were viewed as potentially containing these four elements: input, process, output, and feedback. Implicitly or explicitly, the occurrence of a team-level function means that all of these four processes have occurred, whether or not they can be directly observed. All of these specific elements, occurring together in a certain context, can be seen as interrelated tasks serving the broader function, which is defined by the goal or purpose of the combined set of actions.

The issue of defining team functions in contrast to other common non-team system functions raises the issue of precisely what a "team" function is, and whether there is a unique set of functions characteristic of teams as systems. In a physical system (including most biological systems) the structure of the system is highly determined and relatively unchangeable because the structure is a physical entity. In other words, there is a limit to variations that can occur in a physical system. If extensive changes do occur, the system itself may be seen as becoming one which is qualitatively distinct from its predecessor. Of course, most systems are not totally determined, since it is possible to add, exchange, or modify pieces of equipment, or to reprogram the control system (computer). But in all of these cases, the modifications involve physical resources only. This is not so in social systems since the elements are not held together by physical bonds.

In the case of so-called "team" functions, the processes are oriented toward a human system consisting of a team or group ranging in size from 2 to 15 members. If the team grows larger than approximately 15 individuals, it begins to look like what is typically defined as an "organization," and functions applying to that size entity are appropriately labelled organizational functions. There one sees team function counterparts that exist in the language of organizational theory, such as the distinction between functional and product division of labor, or matrix versus hierarchical organizational structure.

To the extent that all open systems require certain functions, they should be seen to occur regardless of the level of the system. Thus, the input-process-output-feedback system characterizes most, if not all, living systems. Beyond that, however, there are functions which presumably are characteristic of only one or a few closely related systems. These functions should not necessarily be characteristic of all open systems. Therefore, to the extent possible, team functions should be unique to teams, even though similar functions might be found in related systems such as larger organizations. In any case, team functions are seen as mainly dealing with the fact that the person-resource-task matrix is highly variable and highly malleable, making teams potentially very adaptable.

Team functions, then, basically serve to create and to maintain a unique and often a short-lived system in which physical resources represented in personnel and equipment are uniquely organized to match a specific task or mission. They are, in effect, mini-organizational functions in which the temporary organization of the team is created in the planning or organization (preparatory) phase and then carried out in the implementation (execution) phase. Other uses of the functions include altering the organization of the team while it is in the process of accomplishing its task in order to adapt to situations as they occur. Motivational functions act to vary the degree of "energy" available to the team and are perhaps comparable to the concept of voltage in electricity. A team operates with a particular set of resources (amperage), but the actual amount of work that can be accomplished is a function of the motivation (voltage).

During the early attempts to use the provisional taxonomy, it was necessary to keep in mind that, implicitly or explicitly, there exists a conceptual or theoretical framework that guides the structure of any classification system. That is, taxonomies do not naturally "exist"; rather, they are constructs created for better understanding some part of a complex universe. Therefore, while striving to employ the provisional taxonomic system, project staff were sensitive to observational events and activities that did not fit well into a niche created by the currently existing categories.

CHAPTER 5

THE REVISED TAXONOMY OF TEAM FUNCTIONS

This chapter describes the revised team function taxonomy. While the new taxonomy bears a substantial similarity to the initial taxonomy, particularly in terms of the function labels, there are a number of important modifications. The chapter begins with a general discussion of the various changes made to the taxonomy and the rationale for making these changes. The revised taxonomy is then presented with each team function defined operationally and characterized as it appears in different phases of the mission. This is followed by general comments and specific examples of some of the functions.

Approach and Rationale

Based on the problems experienced in the early attempts to use the provisional taxonomy in actual team settings, the taxonomy was carefully reexamined. This was done with the intention of making the function categories clearer and more distinct from one another. One of the first steps taken in revising the taxonomy was to eliminate the original organizational scheme of the taxonomy. Functions were originally organized into four categories: Team Orientation, Team Organization, Team Adaptation, and Team Motivation. The primary problem with this particular organization was that many of the functions classified as organizational in nature could also be seen as serving adaptation functions, and vice versa. In other words, functions were defined in the provisional taxonomy such that specific subfunctions could fit into more than one functional category. To reduce this problem, the functions were reorganized into the following categories: Orientation, Resource Distribution, Timing, Response Coordination, and Motivational Functions. The processes which were implicit in conceiving of functions as either organizational or adaptive were now considered to represent activities inherent in the Resource Distribution, Timing, and Response Coordination functions.

By recognizing the existence of mission phases, it was possible to create a taxonomy in which a relatively small number of team functions were seen as likely to occur in all phases of the mission, even though the particular activity characterizing the function might vary somewhat in the different phases. For the purposes of this report, two general phases were seen in the accomplishment of a mission: the "preparatory" phase (which involves planning and organization) and the "execution" (or implementation) phase. It seems quite likely that at some point in the future this dichotomous category system may have to be expanded and more phases explicitly recognized. One phase, in particular, which is not dealt with here but may characterize most missions, could be called the reconsolidation phase. This phase would normally occur at the end of the mission, although sometimes it could occur in the midst of the execution phase and represent a period in which the execution phase is temporarily halted and an interim reorganization is effected, after which the execution phase resumes. It is not considered further here, because it is usually quite similar to the preparatory phase for the next mission.

Orientation focuses on developing a team-status awareness within the team members via information exchange. The Orientation subfunctions in the provisional taxonomy were defined in terms of the content of the team awareness--i.e., whether the focus was on team resources, goals, tasks, constraints, progress, etc.

It must be remembered that all the functions in the taxonomy involve an informational component. To minimize confusion, it was necessary to distinguish the informational aspects of these other functions from the general Orientation Function. This distinction was made by conceptualizing Orientation as "direct" (as opposed to "indirect"). Although the information processes that are part of the other functions have orientation or awareness properties also, these are considered to be indirect orientation, since the primary purpose of the information flow is to monitor and adjust team resource/task matchings. This kind of indirect information flow was not included in the definition of the general Orientation Function.

As seen in Table 1, the original taxonomy proposed four Orientation subfunctions: Orientation regarding team goals; orientation regarding team tasks; orientation regarding member resources and constraints; and orientation regarding situational resources and constraints. These original subfunctions were restructured only minimally in the revised taxonomy. Team goals and tasks were considered to be so closely related that they were combined into one content category (Information Exchange Regarding Team Task and Goals/Mission). Two subfunctions--Member Resources and Constraints, and Situational Resources and Constraints--were seen as reasonably distinct from one another and were retained in the revised taxonomy, with only a slight word change to the latter. The former subfunction relates to the internal environment of the team while the latter relates to the external environment. All three subfunctions appeared to exist as observable components of team orientation behavior.

In addition, Priority Assignment Among Tasks was added as a new subfunction under the Orientation category. This subfunction was originally included under the Team Organizational category in the provisional taxonomy. However, since it provides direct information regarding the status of team tasks it was shifted to the Orientation category.

During the process of revising the provisional taxonomy, two other content areas appeared as possible Orientation subcategories. They were: (1) information exchange regarding task/resource matching or team structure (in other words, who is doing what); and (2) information exchange about progress on the task/mission, including both quality and speed information. Although these two content areas were initially considered distinct from the other content areas, they were later determined to be special examples of content areas already delineated. For example, information about task/resource matching actually focuses on the relationship between task and resources, each of which is a separate content area in the revised function scheme. It was decided, however, that this type of information should be considered part of the task orientation function because, in most instances, the task definition tends to reflect the resource situation. Similarly, it was decided that progress or status reports on how the team is doing should be treated simply as emergent information about the task itself, and therefore, as part of the task orientation function also.

Conceivably, there could be situations where these special content areas might be usefully distinguished from one another. In fact, it is conceivable that an orientation function could exist for each of the other major function areas (e.g., Resource Distribution, Timing, Response Coordination, and Motivation). It is even possible that an "orientation to orientation" function could be a useful category, reflecting information exchange in planning how information and communication are to be provided. These potential categories are candidates for future study.

A final problem involving the Orientation Functions had to do with the fact that information usually has a motivational effect on the listener. For example, an information exchange on team progress can serve as a powerful motivator simply by providing a general awareness of the current state of affairs or by acting to initiate adjustive behaviors. Similarly, several of the team Motivational Functions proposed in the provisional taxonomy are essentially Orientation Functions that yield information about a reward contingency (e.g., Establishing Team-Level Performance-Rewards Linkages). Although the issue here seemed to be one of whether to define the functions as orientational or motivational, it was decided that to make such a distinction would be forcing an artificiality on events and was not warranted. This example illustrates how specific behaviors can reflect more than one function.

Although Motivational Functions were retained in the revised taxonomy, they continue to be one of the most difficult to define and observe. Many of the Motivational Functions listed in the original provisional taxonomy, in fact, often occur long before a particular task is accomplished by the team. Therefore, it is somewhat awkward to have them incorporated in a taxonomy of team functions. Nevertheless, it was felt that these processes do occur and should be recognized. Detailed operational definitions of the Motivational Functions are not provided in this chapter, although the labels suggested in the provisional taxonomy are retained in the revised taxonomy.

As mentioned earlier, three subfunctions listed in the provisional taxonomy under the Adaptation category were dropped during the reorganization of the taxonomy. Two subfunctions were eliminated because they were largely redundant of functions considered to be Team Organizational Functions. These were Mutual Compensatory Performance and Mutual Compensatory Timing. The former is now considered to be essentially synonymous with the Resource Distribution function. The latter is considered to be synonymous with the Timing and Response Coordination Functions.

The third Adaptation Function to be eliminated was Mutual Critical Evaluation and Correction of Error. This function was seen as occurring at too narrow a level to be considered in the taxonomy. It is now considered to be a dimension which, in effect, subserves all of the other functions. In other words, all functions include monitoring and error correction within the broad function transaction.

It is important to note that the revised taxonomy presented below is still in a developmental stage, there being at least two closely intertwined issues that have yet to be resolved. One issue concerns the very real problem of distinguishing between the functions conceptually and operationally, particularly in terms of observing them. Another issue has to do with whether or not the subfunctions within each general category of functions are truly independent functions, or simply varying degrees of the more broadly defined function. In other words, there is the question, for example, of whether or not Matching Member Resources to Task Requirements and Load Balancing are really separate and distinct functions, or whether they represent varying degrees of sophistication of the same, more broadly defined function which is now called Resource Distribution. These issues are discussed in the presentation of the function definitions and descriptions.

A closely related issue involves the actual measurement and scaling of these functions. Basically, the question is whether or not the functions should be considered all-or-none, or a graded dimension in which an action or team is characterized as reflecting more or less of the same function. Both approaches have their merits and their drawbacks, and there is no theoretical reason for selecting one method over the other. In the final analysis, the particular approach taken will depend upon the use to which the functions will be put, and the ease with which it is possible to view and characterize behavior as reflecting one function or another. It is also necessary to decide whether the focus of the observation will be the entire team or subgroups of team members, and to determine the boundaries of a behavioral episode.

The Revised Taxonomy

The following section presents a detailed description of the revised taxonomy, which is summarized in Table 2. In general, each function description begins with the current working definition and includes the

TABLE 2

Revised Taxonomy of Team Performance Functions

I. Orientation Functions
   - A. Information Exchange Regarding Member Resources and Constraints
   - B. Information Exchange Regarding Team Task and Goals/Mission
   - C. Information Exchange Regarding Environmental Characteristics and Constraints
   - D. Priority Assignment Among Tasks

II. Resource Distribution Functions
   - A. Matching Member Resources to Task Requirements
   - B. Load Balancing

III. Timing Functions (Activity Pacing)
   - A. General Activity Pacing
   - B. Individually-Oriented Activity Pacing

IV. Response Coordination Functions
   - A. Response Sequencing
   - B. Time and Position Coordination of Responses

V. Motivational Functions*
   - A. Development of Team Performance Norms
   - B. Generating Acceptance of Team Performance Norms
   - C. Establishing Team-Level Performance-Rewards Linkages
   - D. Reinforcement of Task Orientation
   - E. Balancing Team Orientation with Individual Competition
   - F. Resolution of Performance-Relevant Conflicts

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*Derived from the provisional taxonomy but not discussed in this report.

original definition provided by Nieva, Fleishman, and Rieck (1978), where such a definition was available. Following that are descriptions of how the function might appear in different team settings and in each of the two basic mission phases--the preparatory phase and the execution phase. Where appropriate, distinctions between functions are discussed, including some of the difficulties that were encountered in making these distinctions. (Function boundaries and definitions are not to be considered final given the developmental nature of the work.)

I. Orientation Functions

Definition: As defined by Nieva, Fleishman, and Rieck (1978), Orientation Functions involve "the processes by which information necessary to task accomplishment is generated and distributed to relevant team members." These functions are intended to instill and maintain awareness of the overall status of the team. They may include information exchanges regarding team tasks, goals/mission, member resources and constraints, environmental characteristics, and priority assignment among tasks.

In the preparatory phase, Orientation is a major overtone of all activities, and at times, may be indistinguishable from informational activities directed at planning for the execution or implementation of other functions. The "orientation" may come as a by-product of the fact that all team members are usually together during this phase, as in a formal briefing period. In the execution phase, Orientation is usually ad hoc information which updates team members on the current status of the internal and external environments.

The four Orientation subfunctions will now be discussed in turn.

A. Information Exchange Regarding Member Resources and Constraints

Definition: This function serves to make team members aware of each other's resources and capabilities. It includes exchange of information about (1) team member/manpower status; and (2) physical resources such as equipment and materials available for task performance.

In the preparatory phase, this information exchange reflects fairly stable and predictable attributes of team members (knowledges, skills, and abilities)--attributes that are relatively constant across varying task environments. The information may also include messages about physical resource availability and dependability. Knowledge of member skills and abilities is often assumed from the amount of previous training and experience a person has had in the existing task setting. Characteristics such as dependability and reliability in getting the job done, however, are more likely to become known after team members have worked together for a period of time. Since this process is not always visible with short-term observational techniques, additional information on the function often needs to be obtained through interviews with squad members. This type of information exchange allows for a matching of abilities to jobs on a more skill-specific and permanent basis.

In the execution phase, the information exchange reflects the status of team members in a more spontaneous and emergent situation. It includes messages about team members' ability or inability to continue in their designated roles, availability for assignment to new tasks, and capabilities as a result of conditions in the immediate task environment. This type of information provides messages about team member status and thus contributes to group awareness of how members are faring in emergent and unstable conditions.

In order for this function to occur in the execution phase, there must be a task environment that allows for an exchange of information (which is often verbal). Additionally, Information Exchange About Member Resources and Constraints may be facilitated by previous plans for information dissemination. Rules such as how and when communication should occur can be established.

B. Information Exchange Regarding Team Task and Goals/Mission

Definition: This function involves disseminating and eliciting information to establish and clarify exactly what the unit is to accomplish.

In the preparatory phase, this function is frequently observed in the operation order, which specifies the type of operation desired and the intended team actions. Information to provide a clear understanding of the overall plan is supplemented by details about tasks and activities which the unit must undertake in order to achieve the team mission. This function entails distributing information and conducting discussion (including questions and answers) to the extent that it is necessary to clarify to the team members what is to be done. The objective is to provide team members with a common goal and an understanding of the role they are to play in accomplishing the goal.

In the execution phase, this function is reflected in information regarding the current status of the team's mission and specific tasks. Changes in the task or mission, as a result of emerging conditions, as well as "progress reports" on how the team is doing in accomplishing its tasks in terms of both speed and quality, are also reflections of this type of information exchange.

This function requires an environment in which information exchange can occur--that is, one in which there is adequate time for discussion to take place. The communication pattern or manner of distributing task and mission information is a critical aspect of this function. For example, which team members are involved in the information exchange session, and how many people or channels the information is passed through, will affect the extent to which individuals have a clear and comprehensive understanding of the unit mission and its component tasks.

C. Information Exchange About Environmental Characteristics and Constraints

Definition: This function provides members with knowledge of situation-specific conditions and factors that will influence the manner in which mission tasks are performed. Pertinent information includes: (1) external support (resource availability, assistance, and reinforcement from extended teams); (2) opposition data (size, location, resources, characteristics, and expected strategies of the enemy); and (3) environmental conditions (terrain, boundaries, weather, visibility, and noise level).

This information, in addition to mission and task information, allows team members to match plans with specific details of the situation. It provides data to adapt mission plans and devise strategies to fit conditions in the environment, thereby tailoring resources and options to task demands. By giving team members an idea of what to expect, special plans for performing in a restrictive work environment, adapting to resource deficiencies, and capitalizing upon known advantages can be made. As with most other information exchange functions, an environment or situation conducive to information dissemination and discussion is needed.

In the preparatory phase, this information exchange reflects the best estimate of the current or expected situation, and is reflected in the "situation" paragraph of the operation order. In the execution phase, the information exchange reflects emerging changes in the situation, and is often a prelude to the occurrence of other functions designed to adjust the team's manner of dealing with its environment.

D. Priority Assignment Among Tasks

Definition: This function involves adjusting a formal task/goal to fit estimated or emerging restraints on resources and time. In this function, the task or mission is defined or redefined to reflect not only the mission as assigned from external sources, but also to reflect team capabilities. Resources and time are seen as being either constant or beyond control, thus requiring the task or mission itself to be the focus of the function.

Two types of prioritization are included. They are:

1. Ordering of specific subtasks including those which should be done without fail and those that can be completely eliminated due to lack of time or resources.

2. Altering the definition of adequate performance by prioritizing qualitative aspects of a specific mission (e.g., "Set up a claymore--that is essential--but lay closer in than originally desired and use less camouflage than SOP").

In the preparatory phase, priority task assignment entails establishing priorities of work (the importance of tasks) through clarifying the relative order in which they should be performed. This function may not be as visible as others, in that task priorities are often SOP or implicit. The function may include stating contingencies under which the necessity to prioritize tasks arises. Such contingencies may be overload conditions such as insufficient manpower, time limitations, and environmental constraints necessitating the accomplishment of some tasks before others, or instead of others.

In the execution phase, priority task assignment involves altering priorities of work in response to the ongoing situation. Orders such as "forget that for now" or "don't worry about the camouflage" would be examples of adjusting task priorities in response to overload or situational changes.

II. Resource Distribution Functions

Definition: Resource Distribution Functions focus almost exclusively on member resources and equipment, and how they are distributed in an effort to accomplish a task. Although consideration of task demands is involved, the task and other characteristics of the situation basically remain constant while resources alone are adjusted. This function category may involve two subfunctions--Matching Member Resources to Task Requirements and Load Balancing.

A. Matching Member Resources to Task Requirements

Definition: This function is defined by Nieva, Fleishman, and Rieck (1978) as "what is typically referred to as division of labor." Its purpose is to distribute member resources in the task in such a way as to maximize effective utilization of member skills. The end result is a decision about who will do what. The basis for making the decision is who, in terms of availability or by nature of the resources they offer, is best able to perform the task in the manner necessitated by existing conditions. If skill/resource assessment is not involved, then the distribution of resources is a Load Balancing Function (to be discussed later in the chapter).

In the preparatory phase, this function takes the form of eliciting or confirming skills and assigning team members to specific positions. This may include "dry run" testing to confirm the match. It may also include contingency plans where more than one position is identified as needing some skill and vice versa.

In the execution phase, the function may involve selective replacement or redistribution of skills/resources where matching of resources with task needs is consciously considered. Depending on the urgency of the situation, this function may degenerate into Load Balancing (redistribution of resources regardless of a skill-task match).

Response contingencies which may determine whether or not the function occurs include:

1. Knowledge of member resources. This knowledge is related to prior exchange of information about member resources

and constraints, an Orientation Function. Types of resources considered under this function include: skills and knowledge (especially job related); physical abilities (e.g., speed, strength, endurance); traits or anticipated behavior patterns (e.g., reliability, temperament, stress response); and motivation.

2. Knowledge of specific task requirements. This includes not only tasks that must be performed, but also subtasks and the specifics of accomplishing them, as well as the abilities required for their successful completion.

3. Availability of member and equipment resources necessary for achieving the match.

4. System of task assignment. This includes the climate allowing for a match of skills with needs regardless of rank and grade of performer.

5. Availability of time for planning and decision making.

B. Load Balancing

Definition: Load Balancing involves adjusting member resources to task/goal requirements in such a way that there are adequate personnel at all points in the system (i.e., for all subtasks). The purpose of the function is to insure that some subtasks are not short of personnel, while other subtasks are overstaffed. The function does not involve a sophisticated matching of skills with task requirements, but focuses almost exclusively on numbers of people on a particular job. Because of its relatively unsophisticated nature, the function tends to occur most clearly in an adaptive mode where quick, on-the-spot changes are necessary during actual implementation of the tasks.

In the preparatory phase, Load Balancing takes the form of developing contingency plans regarding how and when to redistribute resources. No implementation actually occurs other than establishing cues, etc. In other words, it involves anticipating possible overload conditions through monitoring, and establishing plans and procedures for dealing with the overload.

In the execution phase, Load Balancing is an adaptative process, in that it occurs as a result of ongoing changes in the task/environment, and takes place as soon as the need is detected and the appropriate activation cues occur. In most cases, it is a compensatory process in which there is an effort to identify and deal with conditions that constitute a task overload or the possibility of an overload situation arising. The function includes mechanisms for identifying and detecting overload, alerting team members to the situation, and responding through changes in manpower allocations. The redistribution of team personnel may be temporary or permanent. Load Balancing can occur as:

1. A monitoring activity that does not result in subsequent actions because overload has not occurred.

2. Actively anticipating conditions that may result in overload situations and implementing changes to allay impending imbalances.

3. Identifying and responding to existing overload symptoms in order to correct the situation once it arises.

Overload or imbalance occurs in situations where a team member(s) cannot accomplish the task(s) at hand or within his/her domain without a change in existing conditions. In Load Balancing, the method of responding or coping with an imbalance or threat of overload is through member assistance in performing the task (as opposed to eliminating the task, which would involve the Priority Assignment Among Tasks Function).

An emergent situation in which a critical task arises without a designated performer to accomplish the task may also constitute overload. One or all of the following factors may contribute to an overload situation which may, in turn, precipitate some adaptation:

1. Inherent task requirements such that the task(s) cannot be accomplished under existing manpower arrangements. These requirements include physical demands of the task and task complexity/difficulty (where resource matching functions are not a viable or selected response).

2. The volume or number of tasks to be performed (where task prioritization or elimination is not a viable solution).

3. Time constraints on task accomplishment (where shortcuts or omissions are not elected responses).

Response contingencies are factors and conditions which may affect whether or not the Load Balancing function will occur in response to overload. These contingencies include:

1. Awareness of the overload situation and knowledge of the need for Load Balancing.

2. Knowledge of the appropriate response to overload (who should do what) which may be determined by personnel availability or may have been established by SOP, contingency plans, or predetermined roles.

3. Availability of necessary resources and opportunity for action (e.g., other task demands on the prospective responders; equipment needed for the task; external obstacles to responding).

4. Task/situation criticality as determined by the possible consequences of not responding to the overload--that is,

the tradeoff between reacting by Load Balancing and failing to respond to the situation. (Note that there is a possible overlap of two or more functions here, with the distribution decision also based on a priority assignment decision within the scope of the Priority Assignment Among Tasks Function.)

5. Desire/motivation to respond which is affected by the interpersonal dynamics among team members, squad unity, morale, etc.

Load Balancing must be distinguished from Matching Member Resources to Task Requirements. While the latter involves matching team member skills to task requirements, in Load Balancing a member-task assignment is based on availability. Often the distinction is not observable, since in most intact teams all members have a common core of skills--physical strength, basic military skills, etc.--and any team member may lend his/her assistance to an overload task. It is possible that these two functions may reflect differing degrees of a single function--for example, a general resource/task matching function in which sophistication of the match increases from none (any warm body will do) to a complex skill/task analysis. In this case, Load Balancing would represent the end of the scale where minimal matching occurs.

III. Timing Functions (Activity Pacing)

Definition; Timing functions involve time as a major component, and organize or coordinate resources in a manner not possible without a chronological component. Activity Pacing is the extent to which a team changes the timing or speed of its task to facilitate the team mission. This function is characterized in Nieva, Fleishman, and Rieck (1978) as "highly related to response coordination." The purpose of the function is to ensure that all individual activities are completed in the time allotted. Two levels of pacing can be distinguished--General Activity Pacing and Individually-Oriented Activity Pacing.

A. General Activity Pacing

Definition: This function is oriented to the whole team--that is, all team members increase their speed, maintain their speed, or decrease their speed. It is designed to (1) maintain a working tempo such that the task will be accomplished in the amount of time demanded by the situation; and (2) to adjust the pace of work so that members will move and perform at a compatible speed. This compatible speed is one at which all members are able to operate as a unit without becoming fragmented due to differences in speed of performance.

In the first condition, General Activity Pacing is a function that responds to task time demands. In the second condition, it is a measure responding to different team member capabilities and a need for synchronized unit performance. For example, if member A cannot keep pace with the unit (and other adaptive functions like Load Balancing and Time and Position Coordination of Responses are not selected responses), the work tempo will be reduced.

B. Individually-Oriented Activity Pacing

Definition: This function is oriented at a specific subset of team members and is designed to speed them up or slow them down so that they are operating in the same time frame. Both General and Individually-Oriented Activity Pacing entail the following:

1. Monitoring to detect performance inefficiencies caused by inappropriate work rates (rates that do not respond to task time demands or that inhibit performance of the group as a coordinated unit).
2. Information dissemination that will maintain or adjust the rate of work.
3. Member response to cues/commands that serve to pace activities.

In the preparatory phase, both forms of Activity Pacing are reflected in information about when the task should begin, at what pace it should occur, and approximately when it should end. This information can include reference to specific environmental cues that help to determine the pace, such as daylight or battle noise.

In the execution phase, Activity Pacing can be seen in commands or requests intended to initiate, direct, or control the timing or speed of events (e.g., "start when I tell you"). Behavioral actions which reflect Activity Pacing involve any apparent adjustment in the speed of task performance in response to a communication or a change in the situation.

Activity Pacing is distinguished from Load Balancing in that it involves no change in personnel or equipment distribution; it is simply concerned with timing and speed. It differs from Orientation in that the information exchange contains a definite implication for action rather than being simply a statement of fact.

IV. Response Coordination Functions

Definition: Response Coordination functions are characterized by Nieva, Fleishman, and Rieck (1978) as functions operating in such a way "that team member activities flow smoothly and do not interfere with each other." The purpose of these functions is to ensure that individual behaviors occur in the proper sequence, and in coordination with other ongoing activities. Response Coordination occurs particularly with tasks that cannot be accomplished independently, and that require the synchronized performance of subtasks and activities.

Response Coordination involves timing in order that one response occurs in a time relationship with another response, but it also includes mechanisms to ensure that the unit operates in a fluid, coordinated fashion, and that team members are aware of and respond to each other's actions in a manner which enhances achievement of the group mission. Two mechanisms or processes have been delineated --Response Sequencing, and Time and Position Coordination of Responses.

A. Response Sequencing

Definition: Response Sequencing is a special case of Response Coordination in which a predetermined series of responses occurs in a specified order, but without a precise timing implication, other than temporal ordering. Sequencing involves an ordinal scale, whereas Response Coordination is on an interval or ratio scale.

In making a distinction between Response Sequencing, and Response Coordination, the issue is again raised as to whether these are separate, distinct functions, or simply varying degrees of the same broader function. Since this is still a developmental stage of the taxonomy, it was decided to keep both functions because of their close conceptual relationship, and also because this was the organization provided in the provisional taxonomy. Nevertheless, it should be clear that we are distinguishing between at least two degrees of the same function (if not two separate functions): (1) Response Sequencing, and (2) Time and Position Coordination of Responses.

B. Time and Position Coordination of Responses

Definition: In this function, two or more individuals are working together to accomplish a task that fewer could not accomplish alone, either because of physical constraints or task complexity. For example; two or three individuals may lift a bridge ramp extension when one person cannot do it alone because of the weight of the ramp. Here the function includes timing and physical coordination--that is, the men must be in certain positions relative to each other as well as the ramp, and must time their activities so that all heave at the same time. The need for position coordination is also illustrated by infantry units moving forward in a wedge formation.

In the preparatory phase, Response Coordination Functions include planning and establishing who does what in relation to others, and when during the sequence of events. It may also include development of contingency plans for altering a particular sequence of events. Included here is the establishment of cues for coordinated actions. The "command and signal" element of the operation order reflects this function.

In the execution phase, actual coordination and sequencing will occur in response to appropriate cues, whether preestablished or emergent in the situation. The functions will occur in a preplanned fashion, or in an adaptive, flexible manner, if the situation changes from that anticipated in the preparatory phase.

Components of the Response Coordination Function include:

1. Planning--i.e., designating tasks, personnel, channels of information flow, and an established cue to initiate activities requiring coordinated behaviors.
2. Monitoring group performance and, if necessary, delivering information and/or cues to orchestrate ongoing activities.
3. On-the-spot exchange of information and/or cues to initiate a chain of related and reciprocal behaviors.

Observationally, these functions present some unusual problems. Although they are often easily identifiable in that they entail both designating cues and using and responding to cues, the actual "visibility" of the cues is often related to the effectiveness of the preparatory stage and the skill of the team members. A smoothly running team operation probably involves a high degree of Response Coordination, but is often not obvious in the same sense that the cue-response contingency in a complex stimulus-laden environment may not be obvious to an outside observer without previous knowledge of the established procedures. Thus, team coordination may be high, while visibility is potentially low. On the other hand, poorly planned coordination is often very obvious, like the violent vibrations of a mistimed engine. In this case, coordination efforts tend to be very visible, as leader and members try to "get it together" by talking to one another. The danger lies in observing a high degree of coordination efforts in a situation where there is, in fact, a low degree of coordination to start with. Ultimately, it may be necessary to distinguish between routine and adaptive/corrective Response Coordination, particularly in the execution phase.

CHAPTER 6

LABORATORY TEST OF THE UTILITY OF THE REVISED TAXONOMY AND MEASUREMENT SCALES

The pilot study described in this chapter represents the first step to develop function measures and determine their reliability. It determined whether naive judges, who were given a short training experience, could detect functions in actual team settings, and whether they could do so reliably enough for subsequent criterion-referenced validation work. To that end, a set of scales measuring four of the taxonomy functions was developed and used in rating 15 team activities viewed via videotape in a laboratory setting.

Functions

Four functions from the revised taxonomy were selected for investigation. They were: Orientation; Resource Distribution (Load Balancing); Activity Pacing; and Response Coordination. These functions were judged by the project staff as being relatively easy to recognize and distinguish from one another. Both Orientation and Response Coordination were defined somewhat broadly for the study by collapsing over several subcategories in the taxonomy. Resource Distribution (Load Balancing) and Activity Pacing, while more narrowly defined, could also be clearly differentiated from one another, as well as from the other two functions. Since this was a pilot study, it seemed important to try to select functions with as little overlap as possible. If subjects were successful in identifying these functions, then functions with finer distinctions could be used in the future.

Another reason for selecting these particular functions was to see if subjects could identify functions that occur in either a communications or behavioral mode. The Orientation Function occurs almost entirely in the communication mode. Resource Distribution (Load Balancing) and Activity Pacing may occur either in the form of a communication or a behavior. Response Coordination, in the situations observed, was almost entirely behavioral. Thus, these four functions provide a range on the communication-behavior dimension.

Operational definitions of the functions, including distinctions between them and examples from everyday life, are presented in the Appendix.

Stimulus Materials

The stimulus materials were color videotapes of mortar field exercises and assault ribbon bridge construction exercises taken by the project staff during an earlier phase of the project. Although infantry field exercises were also taped, it was decided not to use these because of the difficulties in detecting the men among the trees and underbrush, and in deciphering their communications.

Tapes were reviewed and edited into fifteen segments, ranging in length from fifteen seconds to two minutes and illustrating varying combinations of the functions, from all four being present in some segments to none being present. Segments were also selected in an effort to show a complete subtask. Thus, a typical segment might show something as simple as swabbing the bore of the mortar, or a more complex task sequence beginning with the receipt of a firing directive from the Fire Direction Center through all of the intervening activities (sighting the gun, preparing the ammunition, etc.) to the actual firing.

Of the fifteen segments, there were eight tape segments portraying mortar squad activities, and seven portraying bridge building activities. Two of the mortar segments were used for training purposes, leaving six mortar and seven bridge segments for testing. Two segments were included as controls (one mortar and one bridge) and contained only individual-level (as opposed to team-level) behaviors. Overall, the individual tape segments differed with respect to each exercise, the specific tasks included, the teams participating in the training, performance levels, and phases of operation. A complete list of the tape segments, with a brief description of the action on each segment, is presented in the Appendix.

In addition to the test segments, two training tapes with accompanying narratives were developed to familiarize subjects with the military training activities they would be viewing during the test session. One tape dealt with mortar squads and one with bridge building. Each tape was approximately fifteen minutes in length, and presented subjects with the entire sequence of team operations--from arrival at the site, to performance of assigned tasks, and finally departure.

Rating Scales

For each of the functions selected, seven-point scales using a behaviorally anchored rating scale (BARS) format were developed to measure the extent to which each function was present in the videotaped segments. Care was taken in using the scaling method because of the great variety of ways in which BARS can be used. Several desirable characteristics should be present in scales developed to rate team performance dimensions. The performance of a team is not a stable trait, but a construct that varies depending on variables such as previous practice and training, specific situational demands, and general mission. Thus, any dimension of team performance can be used for such diverse purposes as assessing training effectiveness (a within-team comparison over time) or comparing the performance of two teams that have very different missions. Any scaling format to be used for such diverse purposes must have several characteristics, in addition to the more commonly examined psychometric properties of reliability and validity.

Specifically, the scales must not be developed with apparent general optimums (such as "higher is better") as their basis. This is particularly important for any comparison of teams with different missions.

For example, consider two crack Army squads from different military occupational specialities (MOS) (say engineer float bridging and infantry), and then think of a set of scales yielding a rating profile of each team's performance. Both of the hypothetical teams may perform their respective missions in a superior/optimum fashion; yet, because of very different task demands, it would not necessarily be desirable for them to yield the same function profile. Relative to the infantry squad, the engineers might exhibit a lower level of compensatory or adaptive behaviors, because their mission does not entail coping and adjusting to a highly emergent task setting. The engineer bridging mission is perhaps more clearly defined and less contingent upon environmental conditions even though such factors as river width and water velocity do change mission or task requirements.

Another consideration in scale development is the selection of anchors that can be applied across many different teams. Most of the time, generality of team scales across many tasks is a difficult objective to attain. Previous experience by researchers in developing BARS suggests that they are often situation-specific, and that separate scale sets must be developed for each new situation. The basic approach taken here, however, was to begin with a set of general anchors with the idea of moving to team/task-specific anchors only if the general-anchor approach was not successful.

For each of the four taxonomic functions included in the pilot study, a set of three or four behaviorally anchored scales was developed. One scale in each function set was designed to obtain a general or overall measure of the function (i.e., the degree to which the particular function was present in the videotaped segment). The other scales in the function set were designed to measure various other relevant dimensions of the function and to test for internal reliability. Altogether, 14 scales were developed--four for the Orientation Function, three for Resource Distribution (Load Balancing), three for Activity Pacing, and four for Response Coordination. A listing of the specific scales for each function is contained in Table 3.

Each of the scales developed ranged from one to seven and contained descriptive labels at the high and low ends of the scale as well as the midpoint to be used as reference points. In addition, each dimension scale included a concise definition of the dimension, information distinguishing it from similar dimensions, and general anchors reflecting different levels of the dimension. A complete set of the 14 scales is presented in the Appendix.

Subjects

Nineteen male undergraduate and graduate students served as subjects. They were all volunteers, recruited from ads and flyers placed at local universities, and were paid hourly for their participation.

Procedure

Test sessions consisted of small groups of two to four subjects and lasted approximately three hours. When subjects arrived, they were given an overview of the project and asked to sign a participant consent

TABLE 3

List of Behaviorally Anchored Rating Scales Used in the Pilot Study

---

- I. Orientation Function
  - A. General Rating
  - B. Number of Personnel Involved
  - C. Duration of Orientation
  - D. Number of Types of Orientation
- II. Resource Distribution (Load Balancing)
  - A. General Rating
  - B. Number of Personnel/Amount of Equipment Involved
  - C. Interchangeability of Men or Equipment
- III. Activity Pacing Function
  - A. General Rating
  - B. Communications About Speed/Timing Changes
  - C. Visible Speed/Timing Changes
- IV. Response Coordination Function
  - A. General Rating
  - B. Involvement of Whole Team
  - C. Complexity of Coordination
  - D. Similarity/Dissimilarity of Activity

form (see Appendix). They were then given a brief oral introduction to the mission and activities of the bridge building team and shown the training tape. The same procedure was repeated for the mortar squad. This part of the experimental session lasted about an hour.

During the second hour, subjects were acquainted with the concepts of "team" and "team function." Then the definition of each of the four functions to be used in the study was discussed separately, and distinctions among the functions were carefully drawn by the test administrator. When the subjects appeared to have an adequate understanding of the functions, they were familiarized with the rating scales and how to use the data collection sheet. Following this, they were presented with two practice (or trial) segments and asked to make their individual ratings. Group responses to these practice segments were then discussed, and any ambiguities cleared up.

During the third hour, the thirteen test segments were administered one at a time. Subjects were seated at a table approximately eight feet from a 17-inch television screen with partitions between them. Each tape segment was preceded by one or two introductory sentences to provide subjects with a frame of reference for viewing the tape. Sometimes this would consist of explaining an unfamiliar phrase in the tape (such as "gun up") or informing subjects how many individuals on the screen to consider as part of the team. Since some of the segments contained extraneous noise (both visual and auditory), subjects were cautioned not to make assumptions about what was taking place on the tapes in the absence of data, but simply to judge on the basis of what they saw or heard. Each segment was shown twice, after which the subjects made their ratings. The test segments were presented in a fixed order at all test sessions, the mortar scenes occurring first, followed by the bridge building scenes.

Subjects followed a two-step process in rating each tape segment. The first step was to decide whether or not each function was present in the segment viewed, and to enter a "yes/no" binary decision in the appropriate space on the answer sheet. Then, for each function perceived as being present, the accompanying set of scales was to be rated. If a function was judged as absent from a particular segment, the scales for that function were not used.

Results

Descriptive Statistics

Tables 4, 5, 6, and 7 present summary information for the ratings on the Orientation, Resource Distribution (Load Balancing), Activity Pacing, and Response Coordination scales. The first column of each table displays the number of subjects that judged the function as present in each stimulus tape segment. The remaining columns present the mean ratings on the three or four scales developed for each function. The ratings were made on scales ranging from one to seven.

The means contained in Tables 4 through 7 were calculated only for those raters who had judged that the taxonomic function was present in a

TABLE 4

Orientation Function Rating Scale Means for Each Stimulus Tape Segment

	Stimulus Segment	Number of Raters Judging Function Present[1]	Behaviorally Anchored Rating Scales[2]			
			General	Number of Personnel	Duration	Number of Types
1.	Preparing for action	7	2.29	3.29	2.86	2.14
2.	Firing one round	16	4.13	4.00	3.25	3.75
3.	Communication to man with aiming stake	5	2.80	3.00	2.80	1.60
4.	Working with ammunition crates[3]	1	1.00	1.00	2.00	2.00
5.	Firing three rounds with safety violation	17	3.41	3.35	2.94	1.29
6.	Firing three rounds (4.2)	14	3.93	4.71	3.79	3.86
7.	Lashing the boat to the raft	1	2.00	3.00	3.00	2.00
8.	Trucks coming aboard the raft	2	4.50	3.00	3.00	1.50
9.	Lifting the ramps	3	4.33	6.67	4.67	2.00
10.	Lowering the ramps	6	1.67	5.67	1.67	1.67
11.	Transferring equipment from boat to bay[3]	1	2.00	3.00	3.00	4.00
12.	Power boat tapping bay	4	1.75	1.50	1.75	1.25
13.	Attaching bay to transporter for retrieval	2	2.00	2.50	3.00	2.00

[1] Out of a total of 19 raters.

[2] Means based on number of raters shown in first column.

[3] Control segment.

TABLE 5

Resource Distribution Function Rating Scale Means for Each Stimulus Tape Segment

	Stimulus Segment	Number of Raters Judging Function Present[1]	Behaviorally Anchored Rating Scales[2]		
			General	Personnel/ Equipment	Interchange-ability
1.	Preparing for action	15	3.47	3.47	4.73
2.	Firing one round	13	4.08	4.15	5.15
3.	Communication to man with aiming stake	16	5.31	3.94	5.25
4.	Working with ammunition crates[3]	6	4.00	4.00	6.00
5.	Firing three rounds with safety violation	5	4.00	3.60	4.00
6.	Firing three rounds (4.2)	13	4.08	3.69	5.46
7.	Lashing the boat to the raft	17	4.06	3.41	5.53
8.	Trucks coming aboard the raft	4	6.75	4.50	5.50
9.	Lifting the ramps	7	5.43	4.00	5.43
10.	Lowering the ramps	10	3.70	3.80	5.00
11.	Transferring equipment from boat to bay[3]	12	4.58	4.75	5.58
12.	Power boat tapping bay	13	5.54	3.31	4.77
13.	Attaching bay to transporter for retrieval	10	5.10	4.40	5.50

[1] Out of a total of 19 raters.

[2] Means based on number of raters shown in first column.

[3] Control segment.

TABLE 6

Activity Pacing Function Rating Scale Means for Each Stimulus Tape Segment

Stimulus Segment	Number of Raters Judging Function Present[1]	Behaviorally Anchored Rating Scales[2]		
		General	Communications	Visibility
1. Preparing for action	18	5.28	4.89	4.22
2. Firing one round	6	4.17	3.17	3.83
3. Communication to man with aiming stake	3	3.00	4.33	2.67
4. Working with ammunition crates[3]	2	1.50	2.00	2.00
5. Firing three rounds with safety violation	6	3.50	2.67	3.50
6. Firing three rounds (4.2)	8	3.50	2.50	3.75
7. Lashing the boat to the raft	4	4.50	3.75	3.75
8. Trucks coming aboard the raft	5	4.20	4.40	3.80
9. Lifting the ramps	3	3.00	2.33	2.33
10. Lowering the ramps	5	4.60	4.00	3.20
11. Transferring equipment from boat to bay[3]	6	4.83	2.83	4.00
12. Power boat tapping bay	4	2.75	3.25	3.50
13. Attaching bay to transporter for retrieval	5	2.60	3.20	3.00

[1] Out of a total of 19 raters.

[2] Means based on number of raters shown in first column.

[3] Control segment.

TABLE 7

Response Coordination Function Rating Scale Means for Each Stimulus Tape Segment

	Stimulus Segment	Number of Raters Judging Function Present[1]	Behaviorally Anchored Rating Scales[2]			
			General	Involvement	Complexity	Similarity/ Dissimilarity
1.	Preparing for action	19	5.37	5.37	4.47	5.05
2.	Firing one round	18	4.28	4.67	3.94	4.72
3.	Communication to man with aiming stake	18	4.22	4.22	3.06	3.72
4.	Working with ammunition crates[3]	11	3.00	5.00	1.46	1.73
5.	Firing three rounds with safety violation	17	4.29	4.94	3.18	3.18
6.	Firing three rounds (4.2)	19	4.84	5.21	3.68	4.42
7.	Lashing the boat to the raft	18	4.89	5.56	3.22	3.89
8.	Trucks coming aboard the raft	19	4.11	2.84	2.53	3.26
9.	Lifting the ramps	19	5.11	5.53	1.84	1.74
10.	Lowering the ramps	17	5.06	5.41	1.59	1.41
11.	Transferring equipment from boat to bay[3]	13	4.00	5.31	3.00	3.69
12.	Power boat tapping bay	17	3.41	3.77	2.94	2.59
13.	Attaching bay to transporter for retrieval	19	4.47	5.16	3.90	4.00

[1] Out of a total of 19 raters.

[2] Means based on number of raters shown in first column.

[3] Control segment.

particular tape segment and subsequently provided ratings on the corresponding scales. Thus, the number of data points contributing to each mean varies from one tape segment to another, and from one taxonomic function to another. The actual number of ratings comprising each mean is shown in the first column of each row.

Generally, when the majority of raters judge that a function is not present in a specific tape segment, the mean ratings for those subjects judging the function as present is expected to be relatively small. This hypothesis stems from the assumption that the dimensions are internally consistent with the taxonomic classification judgments regarding the presence of the function. Although the data presented in Tables 4 through 7 provide some support for this hypothesis, the pattern is not completely consistent. This result may be a function of the larger variance of means based on few ratings. Alternatively, the finding may suggest that at least some subjects were not interpreting the function and scale definitions in the same way.

Reliability of Ratings

As discussed previously, two types of ratings data were collected. First, raters were asked to decide whether or not each of the four taxonomic functions was present within each tape segment. The data resulting from this rating process consisted of binary decisions representing the presence or absence of each taxonomic function for each tape segment for each rater. Second, raters were requested to provide ratings on the scales for each tape segment in which they decided a specific taxonomic function was present. These scales indicated the degree to which several different dimensions of the function were evident in the tape segment as well as the extent to which the function as a whole occurred in the segment.

The reliability of the presence/absence decisions was estimated using an intraclass correlation coefficient based upon the 19 raters' decisions for the 13 tape segments. Table 8 presents the estimated reliability coefficients for each of the four taxonomic functions investigated. The coefficients correspond to the ICC (2,1) coefficient presented in Shrout and Fleiss (1979). Consequently, the estimates are based on the assumption of random effects for raters and tape segments, with between-rater differences treated as one component of error. It can been seen in Table 8 that the raters showed a higher level of agreement in identifying the presence of the Orientation Function than they did in identifying the other functions.

The reliability of the scale ratings was somewhat more difficult to determine. Because the raters only provided these ratings when they decided that a taxonomic function was present, the resulting data structure was not completely factorial in nature. That is, not every rater provided a data point for every scale by tape segment combination. Thus, the data were not amenable to standard analyses of variance leading to intraclass correlation coefficient estimates of reliability.

An alternative procedure based upon effect-coded multiple regressions was therefore derived to yield estimated reliabilities for the

TABLE 8

Reliabilities of Presence/Absence Decision for Each Taxonomic Function

Function	Intraclass Correlation
Orientation	.387
Resource Distribution	.167
Activity Pacing	.180
Response Coordination	.160

scale ratings. Specifically, for each scale, an effect-coded multiple regression was performed with the ratings as the dependent variable, and dummy vector sets for the rater effects and the tape segment effects as independent variables (cf. Kerlinger & Pedhazur, 1973). Due to the nature of the data collection, the two vector sets were non-orthogonal (i.e., not independent). Although the regressions can generally be thought of as mimicking the corresponding analyses of variance, the lack of independent effects requires an a priori order of entry for the independent variables to achieve partitioned sums of squares summing to the total sum of squares. Since between-subject effects are normally treated as an error component with respect to reliability (assuming random raters), a conservative estimate of between-tape segment effects (true variance) is obtained by entry of the dummy coded rater vectors prior to the tape segment vectors. After the variance is partitioned in this manner, the derivation of omega squared estimates is relatively straightforward (cf. Hays, 1973, p. 682). When these estimates are treated as intraclass correlation coefficients, the Spearman Brown formula can be used to provide an estimate of the reliability of the mean rating for ten judges (cf. Shrout & Fleiss, 1979).

Table 9 presents the estimated reliabilities for the scales where the coefficients were derived in the manner described above. The first column presents the estimated reliabilities for a single judge. These coefficients are conservative estimates of the proportion of ratings variance due to true between-tape segment differences in the perceived level of the taxonomic functions. The second column of the table presents coefficients for the mean ratings by ten raters and can be interpreted as conservative estimates of the proportion of variance in the mean ratings by ten judges attributable to "true" differences in the tape segments.

Most of the scales resulted in moderate levels of reliability consistent with reliabilities typically obtained for similar scales in other studies (Schemmer, 1982; Fleishman & Hogan, 1978). Generally, decisions (or actions) based on ratings data are based upon consensus or mean ratings. Consequently, the estimates displayed in the second column of Table 9 are important.

With the notable exceptions of three scales, approximately 50% to 75% of the variance in mean ratings by ten judges can be attributed to actual differences in the degree to which these functions were judged present. The reliabilities of the Personnel/Equipment and Interchangeability scales of the Resource Distribution Function, and the Visibility scale of the Activity Pacing Function were considerably lower than the reliabilities of the other scales. An examination of the data indicated that these smaller reliabilities may be due to smaller between-tape segment variance as opposed to larger error variance terms. That is, the raters were not exhibiting greater disagreement in using these scales; rather, they did not judge the 13 tape segments as having differing levels on these scales.

TABLE 9

Estimated Reliabilities of the Rating Scales

Scale	1 Judge	10 Judges
Orientation		
General	.187	.697
Number of Personnel	.231	.750
Duration	.115	.565
Number of Types	.361	.850
Resource Distribution		
General	.070	.429
Personnel/Equipment	0	0
Interchangeability	.017	.147
Activity Pacing		
General	.091	.500
Communications	.132	.603
Visibility	.006	.057
Response Coordination		
General	.102	.532
Involvement	.148	.635
Complexity	.254	.773
Similarity/Dissimilarity	.374	.857

Interscale Correlations

The next step in the data analysis was an examination of the degree to which the various scales within each of the four taxonomic functions were correlated. An examination of such correlations allows tentative conclusions regarding the utility of gathering multiple scale ratings and the internal consistency of the scales grouped by taxonomic function. If the scale ratings show moderately low levels of correlation, it can be inferred that raters are distinguishing among the scale dimensions and applying them differentially. Conversely, if the scale ratings are highly correlated, then the raters are not differentially applying the scales and, in effect, multiple ratings on one dimension are being gathered.

It is also possible that the various scale dimensions tend to co-occur across tape segments. That is, the possibility exists that pairs of scales represent different dimensions which happen to be present to similar degrees in the set of 13 tape segments. Any resulting covariance across tape segments would therefore be due to a "real" correlation between function dimensions even if raters were distinguishing among the function scales. To partial out this possible data effect, all correlations were based on within tape segment covariance of scale ratings. Specifically, for each of the 13 tape segments, the interscale correlations were calculated across those raters who had decided that the taxonomic function was present and had subsequently provided ratings on the function dimensions. Then, for each scale pair within a taxonomic function, a sample-size weighted mean correlation was calculated utilizing Fisher's r to Z transformation. Table 10 presents the mean within-tape segment interscale correlations derived in the above manner.

In general, the scales within each taxonomic function show moderate levels of correlation. Further, the magnitudes of the interscale correlations are consistent with the reliabilities of the component scale pairs (see Table 9). For example, for the two low reliability scales in the Resource Distribution Function (Personnel/Equipment and Interchangeability), an effective correlation of zero was obtained. The correlations in the table are generally large enough to indicate that the multiple scales within each dimension were being used consistently by the raters. However, the correlations are not large enough to imply total redundancy. Further research is needed to address the utility of the multiple scale approach.

Discussion

Considering the preliminary and prototypic nature of the scale development process, the results are encouraging. With few exceptions, the rating scales had levels of reliability which were moderately high and well within the range of values typically obtained for these types of scales. They clearly represent a satisfactory level for the first application of the taxonomy by relatively unsophisticated judges. Reliabilities would be expected to increase if expert judges were used after a somewhat extended training period. Overall, the Orientation Function scales appeared to have the highest reliabilities. Response Coordination also yielded fairly high levels of reliability.

TABLE 10

Average Interscale Correlations within Tape Segments

Orientation

	General	Number of Personnel	Duration
Number of Personnel	.374	--	--
Duration	.679	.435	--
Number of Types	.296	.400	.419

Resource Distribution

	General	Personnel/ Equipment
Personnel/Equipment	.593	--
Interchangeability	.256	-.022

Activity Pacing

	General	Communications
Communications	.577	--
Visibility	.405	.115

Response Coordination

	General	Involvement	Complexity
Involvement	.416	--	--
Complexity	.588	.323	--
Similarity/Dissimilarity	.406	.223	.478

There are, however, a number of problems that indicate a need for more work before the scales are ready for training and diagnostic applications. In general, there appeared to be what might be called an acquiescence response bias in using the scales. That is, subjects were inclined to say the function was present when project staff felt it was not, or to see it to a higher degree than judged by the project staff. This can be seen in the fact that, in the control segments (tapes 4 and 11), none of the proportions ever reached 0.0. This presence-absence discrimination was best for the Orientation Function where only one subject indicated that he saw the function in each segment, as opposed to the Response Coordination Function where more than half of the subjects indicated that they saw the function in both segments. These discrepancies are probably related to the effectiveness of the training given to subjects. Perhaps the training segment distinguishing between coordination and non-coordination in situations with high activity levels was inadequate. Such an acquiescence bias could also explain those instances in which a majority of judges decided that a function was not present, and the remaining judges rated the function as present at a relatively high level. One hour is certainly not a lot of time to turn naive subjects into experts on detecting team functions. In fact, considering that the judgments required an inference about the purpose of the behavior observed, the effort was relatively successful.

Several other problems are also apparent in the results. One of the scales (Activity Pacing--Communications About Speed/Timing Changes) was inadvertently given an implicit zero end-point in the verbal anchor, while all the other scales have an implicit non-zero baseline as the end point. However, this error apparently had little or no effect on the scale's reliability, and similarly, a minor effect on the scale mean.

Three of the scales yielded very low reliability estimates. Activity Pacing (Visibility) had a reliability of only .057. This was not too surprising, given that this is probably one of the harder scales to use. What was more surprising was the fact that the Resource Distribution scales were applied so unreliably. This function was considered relatively easy to observe and was expected to have higher reliabilities. Clearly, future work will require a closer examination of these functions and scales to determine the precise cause of their poor showing.

A related question that needs review in future research concerns the adequacy of the scale anchors. Perhaps some other dimensions of these functions could have resulted in higher reliabilities. One scale (Response Coordination--Similarity/Dissimilarity) obtained very satisfactory reliability values. However, the question of whether this dimension is really central to Response Coordination or whether it is a dimension which is unrelated to the global function is one which needs further study. Finally, of course, the Motivational Functions must eventually be dealt with in some satisfactory manner.

CHAPTER 7

FUTURE RESEARCH PLANS AND CONCLUSIONS

Although the laboratory study described in the previous chapter represents an important step in the development and validation of the taxonomy and measurement scales, a great deal more work needs to be done in moving toward the eventual goal of empirically studying Army teams performing their primary functions in realistic settings. The first part of this chapter contains recommendations for future research and discusses some of the strategies and issues that must be considered in planning such research. It begins by discussing the need for further developmental, well-controlled, laboratory-based research, and then proceeds to a discussion of the observation of large numbers of Army teams in various settings. The second part of the chapter summarizes the conclusions of the present project.

Recommendations for Future Research

As indicated in the previous chapter, additional work on the measurement scales and the taxonomy should probably be undertaken prior to their full-scale implementation. For example, the function definitions used in the pilot study were broadened somewhat from the formal taxonomic definitions provided in Chapter 5. This step was taken so that the preliminary laboratory validation study could be carried out in a broad, developmental context. In future research, it would be useful to focus the definitions used in the training materials, and perhaps to include additional functions.

The reliabilities obtained in the laboratory study clearly indicate the need to provide subjects with additional training. Training could be improved by giving more examples of the specific functions being defined, as well as clearer and more specific examples of the distinctions between functions. It seems likely that adding three or four more practice tapes (only two were used in the study) would substantially improve the level of training and therefore reliability--particularly if the practice tapes contained illustrations of specific definitional or rating problems. One problem that might be addressed in an expanded training program is the tendency to respond toward the high end of the scale. Other rating problems associated with specific situations could also be dealt with in an expanded training program, with the hope that practice on these kinds of problems would generalize to new situations. Information of this type could be obtained by examining scale usage in different settings that have identified similarities and dissimilarities.

It is recommended that the next study in this series also be conducted in a controlled, laboratory setting using videotaped stimuli. This recommendation is consistent with the general principle of maintaining as much control as possible during the developmental stage of an effort and proceeding in a systematic fashion. While it would probably be informative to use some of the same stimulus materials utilized in the pilot study, it would also be important to add or substitute a variety of new stimulus segments. These can be obtained from existing materials or by videotaping new scenes. If additional videotaping is contemplated, it is recommended that teams which operate in a repetitive mode and in a fairly restricted geographical area be observed. The best example of this requirement from the pilot study was the mortar team.

If a decision is made to obtain stimulus materials from teams that do not fit this description (e.g., infantry squads on movement-to-contact maneuvers), then it is probably advisable to create the scenes artificially by directing the action along certain lines and at certain times. With proper development of scenarios, based on real-life observations, it is possible to obtain videotapes that are just as realistic and of much higher quality than those obtained by simply taping ongoing, unrehearsed training activities.

The number of raters to be used in future studies will depend, in part, on the level of reliability that is considered acceptable by the researchers. As indicated in Table 9 in the preceding chapter, most of the rating scales, even at this early stage of development, achieved acceptable levels of reliability with ten judges. Presumably, the reliabilities would increase with improved training, and it may be possible to utilize as few as two or three judges in some applications.

Constraints on the types of judges used should be determined by the particular goals of the research. A more sophisticated use of the scales--for example, using them to determine optimal amounts of a particular function in a particular situation--may require qualitative judgments that only certain types of experts can make. In these types of criterion-related studies, therefore, it may be advisable to use job-content experts. However, for simple detection of functions, anyone familiar with the tasks and goals, and with the function definitions should be able to make adequate judgments with proper training. As indicated by the results of the pilot study, totally naive subjects can apparently be trained to reliably detect the presence of functions in two very different Army settings.

Eventually it will be necessary to validate the scales in an actual Army field setting. From the broadest validation point of view, it is desirable to study as many different types of teams as possible. In terms of maximum utility for the Army, a sampling of combat, combat support, and service support teams should be undertaken. Several different tasks and task settings should be studied within each of these broad categories. The duration and complexity of a particular task setting should also be considered in making judgments. For example, it may be necessary to experiment with the ability of judges to make accurate ratings over differing time frames. In the pilot study, ratings were based on scenes with durations not exceeding two minutes. Teams and tasks should also vary in the extent to which they use a few or many people. Almost inevitably, large, highly interactive teams are going to be more difficult to describe than small teams operating in a minimally interactive mode.

Construct validation of the taxonomy and the measuring instruments is most likely to be effected by means of criterion-referenced procedures, as specified in some model of team performance proposed by job experts. For example, a mortar expert might develop a model of mortar effectiveness by proposing certain relationships between the functions and team performance. Such factors as weather, condition of the equipment, level of strength of the team, amount of experience the individuals in the team have, as well as the amount of experience the team members have working with one another as a team, would all be factors that would have to be included in a comprehensive model of mortar crew effectiveness. Then, using acceptable criteria of mortar crew performance, such as speed of resounding to various commands and accuracy in carrying out the fire direction center orders, performance would be correlated with the various ratings of the functions. To the extent that the relationships were consistent with those proposed in the model of mortar team performance, the functions would be validated.

A somewhat less rigorous form of construct validation would not require the intervening step of a model of crew performance. Instead, a number of teams would be observed and rated. These teams would be identical in terms of their mission and equipment--for example, dismounted 81 mm mortar squads firing at the command of a fire direction center. The teams should vary systematically on certain dimensions considered to be critical to the operation of the team, such as those listed in the paragraph above. Function profiles for each of these subcategories of teams would then be developed for those teams considered to be ineffective.

It should be possible to develop reliable profiles which characterize each of these subcategories and which are reliably different from one another. For example, the function profiles of an effective mortar crew consisting of recent graduates of Advanced Individual Training (AIT) who have never worked together before should turn out to be different from the function profiles of an ineffective mortar crew of similar composition. One might expect high levels of Orientation and Response Coordination in the highly effective teams, but much less activity of this type in the ineffective teams. On the other hand, for highly qualified, long-term teams, the opposite pattern might be expected. This type of approach has the advantage of allowing the data to determine what the relationships are, rather than our attempting to intuit them before the fact. In the long run, this may be a more desirable data analytic strategy to follow.

In summary, then, there are still a number of intermediate, developmental stages which need to be accomplished before any final implementation of the taxonomy or its measuring scales occurs. The particular research path chosen will depend on the ultimate goal of the research, whether for diagnostic purposes, training purposes, or purely theoretical purposes. The recommendations and guidelines proposed above should assist any research strategy in accomplishing its goals.

Summary and Conclusions

The Army's need for more effective teams is clear. Training is obviously an essential part of addressing this need--in particular, training on team functions which would help members to more effectively incorporate their skills into a mission-related product. This type of training, however, is almost non-existent because of the current lack of understanding in this area of team behavior.

The work described in this report represents a significant step toward understanding the problems of team effectiveness. It focuses on the development of a conceptually sound taxonomy of team functions that is, at the same time, a useful device for guiding the development of procedures to measure team activities. The report also highlights many of the conceptual as well as practical problems involved in developing and implementing a taxonomy of team functions.

The early attempts to use the provisional taxonomy developed by Nieva, et al. (1978) indicated both strengths and weaknesses in the original taxonomy. These findings led to a reanalysis of the taxonomy, resulting in more precise definitions and distinctions between the functions, as well as an overall reorganization of the taxonomy. Conceptually, the main issue was how to classify the various functions into a taxonomic system that was neither so narrowly stratified as to be unwieldy and confusing, nor so broad as to lose useful distinctions for understanding team activities. The revised taxonomy represents a first attempt at operationalizing the function definitions.

The laboratory study described in Chapter 6 indicated that naive raters could make reasonably reliable observations of team functions in the proper circumstances and with adequate training. One of the problems encountered, however, involved a tendency to "see" a function when it was not really there (acquiescence response bias). This problem indicates a need to improve the observer training somewhat, but also suggests that the conceptualization and definition of the functions need more work in order to permit functions to be more easily differentiated.

As a whole, the project demonstrated that it is possible to use the taxonomy in military settings and that the rating scales are usable for at least two totally different military settings and missions. The work is clearly still in the developmental stage and requires substantial additional work before the taxonomy and its related measuring instruments are ready for operational purposes.

Ultimately, of course, the goal is to relate team functions to observable criteria of team effectivenses. The next step in this project, therefore, should probably include some criterion-referenced validity work in which military experts are trained in the meaning and observation of the functions. Their judgments about team effectiveness would then become the criteria against which the rest of the team function data could be validated. Once the link between team functions and observable criteria has been successfully established, it will be possible not only to observe team functions, but also to train teams to more effectively accomplish their missions. This project provides a basis for additional research which will eventually lead to the accomplishment of these goals.

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APPENDIX: EXPERIMENTAL MATERIALS

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INTRODUCTION TO STUDY

Welcome to the Advanced Research Resources Organization. My name is Sam Shiflett and this is Ellen Eisner. We will be working with you during today's session.

The project in which you will be participating today is sponsored by the Army Research Institute. It is concerned with the question, "What is teamwork, and what makes a team successful?" As I'm sure you realize from your own experiences, the success of an activity in which two or more people are involved is not necessarily guaranteed by the individual skills of the people involved. Very often it is the presence of another factor--the ability to work together and coordinate as a team--that determines the degree of success of an operation. This project focuses on the teamwork aspect of group interaction. It attempts to define or break down the concept of teamwork into discrete or separate team functions which can be observed. Ultimately, if it turns out that we are successful in describing or delineating team performance, it will become possible to develop programs for training the functions in a team context. The long range result then is that team performance may be enhanced.

What I have just given you is a broad overview of the project. Let me now be more specific about what you will be doing. We have already developed a preliminary list of team functions, and are now at the point where we are ready to test their usefulness. You will be viewing videotape segments of actual teams at work, and we will be asking you to pick out or identify the team functions which you see. We will also ask you to make certain judgments about these functions on the rating sheets that we have prepared. These judgments deal with the amount or extent of the function present, its frequency, etc. Naturally, in order to do this, you will have to have some training in what the functions are, and some background information on the work performed by the particular teams you are observing.

Our game plan is as follows. First we will familiarize you with the two types of teams that you will be viewing on the videotapes--the Army bridge building team and the Army mortar squad. Then we will familiarize you with the team functions. We will explain them to you in detail and make sure that you understand their meaning. We will also go over the rating sheets you will be using to record your judgments. Following all this, we will begin the testing itself. The entire training and testing procedure should take approximately three hours.

Do you have any questions at this point?

O.K., before we can begin, I need you to complete this consent form (pass out forms). The form basically repeats the information I have just given you about the study. It also contains a statement about the manner in which we will treat the data collected in the study and the confidentiality of your individual responses. Please take a moment to read and sign this form.

O.K., if there are no further questions, we will begin the training.

PARTICIPANT AGREEMENT FORM

You will be participating in a study designed to investigate team performance in terms of its component parts or functions. The study is sponsored by the Army Research Institute. Its purpose is to isolate and define aspects of teamwork which can subsequently be trained and used for improving team performance.

What we will ask you to do is view videotaped segments of Army mortar and bridge building teams, and decide whether certain team functions are contained in these films. We will provide you with definitions of each function and an explanation of the scales for recording your judgments. We will also familiarize you with the goals and duties of the mortar and bridge building teams by showing you two training films which we have prepared. The entire training and testing procedure will take approximately three hours.

You will be paid $20 for your participation in this study. As a volunteer, of course, you are free to withdraw from the study at any point; however, since we must discard the data of anyone who withdraws, we urge you not to become a participant at this time unless you intend to complete the session. (If you do withdraw for any reason, you will be paid at the rate of $3 per hour for the time you have participated.)

The data collected in this study will be held in strict confidence. No individual participant will be identifiable by name, and data will be presented in statistical form only.

There is no risk to your safety or health from participation in this study.

I certify that I understand the research described above and am aware of the nature of my participation in it. I hereby agree and consent to serve as a subject in this study.

date	signature

NOTE: Extra copies of this consent form are available from the study administrator if so desired.

INTRODUCTION TO THE CONSTRUCTION OF AN ASSAULT RIBBON BRIDGE

An assault ribbon bridge (or raft) is constructed during an assault mission when equipment or vehicles must be moved across a body of water, such as a river or a wide stream. The ribbon bridge consists of separate bays or sections. Each bay is about twenty feet long and wide enough to accomodate most Army vehicles. The bays are linked together to form a bridge or raft. The length of the bridge can vary, but there must be at least one interior (or central) bay and two exterior bays or ramps for loading and unloading.

In the films you will be seeing in a few moments, a five-bay raft will be constructed; it will have three interior bays and two ramp bays. The bays open and close like an accordion and are transported to and from the river in specially designed trucks called transporters. Power boats are used to maneuver the bays in the water during the assembly process. The boats are also used to provide power when the bridge is used as a raft, and provide stabilization when it is used as a bridge. The boats are transported to and from the river in specially constructed trucks which have a cradle for the boat to rest in.

Generally speaking, the process of assembling the ribbon bridge consists of the following steps. First the transport trucks carrying the bays, boats, and bridge personnel arrive at the site. The transporters back up to the water for unloading the bays and boats. The boats are launched first. One boat serves as a safety boat and is stationed downstream during the entire operation. The other boats are used to maneuver the bays to the appropriate location on the river. After the boats have all been launched, the bays are released into the water one at a time. As each bay is launched, one of the power boats is tied to it. That boat then propels the bay to its desired location.

In the films you will be observing, two central bays are each maneuvered by a power boat operator toward the center of the river. The power boat operators then guide the bays together. When they are properly positioned, the assembly crew connects the bays One boat remains lashed to the two-bay unit while the other boat returns to the launch site to pick up the third central bay which is being launched at that time. The third bay is maneuvered to the two-bay unit and attached. A similar procedure is followed for each of the two ramps or end bays. After the raft has been completely assembled, the power boats are attached to its side and used to propel and maneuver it across the river with its cargo. A five-bay raft can usually be constructed in 20 to 25 minutes under good conditions (e.g., if current velocity isn't too great).

The job of assembling and disassembling the ribbon raft is performed by an Engineer Bridge platoon. The platoon is divided into two sections: (1) a transporter section made up of 25 individuals, and (2) an assembly section made up of about 28 individuals. The transporter section, as its name implies, is in charge of transporting the bays and boats, and for launching and retrieving the bays and boats. The assembly section is responsible for the actual assembly and disassembly of the bays. The platoon sargeant usually serves as the raft commander and coordinates the anchoring process when one bridge is anchored at the shoreline.

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NARRATIVE FOR TRAINING TAPE ON THE CONSTRUCTION OF AN ASSAULT RIBBON BRIDGE

__NOTE:__ The narrative which follows was prepared to accompany the training tape on constructing a ribbon bridge. Although it would have been useful to indicate the corresponding counter numbers on the tape, the equipment used (Sanyo Cassette Recorder VCR500) did not have a reliable counter--i.e., the numbers on the counter changed with each presentation. Major scene changes therefore are separated in the narrative by paragraphs. The symbol "//" is used within paragraphs to indicate places in the narrative where the test administrator needed to pause or wait for a new scene to appear.

(START TRAINING TAPE)

In the first scene you'll see one of the power boats being launched into the river. You can also see a view of the transporter as it pulls away from the shore. // Now the boat is moving out in the river to prepare for connection to the first bay.

The next scene shows the launching of the first of the central bays. Immediately the boat comes over to attach itself to the bay. The men lash the boat to the bay with ropes. This is done so that the boat can maneuver the bay in the water. It also enables the men to run back and forth between the boat and the bay, carrying material onto the bay that is necessary for constructing the raft. Basically here you are seeing routine preparatory actions for receiving the next bay.

The next scene shows the launching of the second central bay. // Again, the boat comes up and grabs it, and then maneuvers it out to meet the first bay. // There's the first bay waiting out in the middle of the river. // The boats maneuver the bays into approximate position to be joined together. // Here the men are using a pole to pull the bays together. //

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Here you see the arrival of the first of the end bays. (We didn't see it launched.) Notice that it rides lower in the water than the central bays. // Now you're seeing the end bay being connected to the two central bays. // Notice that here the pole is being used as a hook to bring the bays together. In the background here you can see the next central bay (the last central bay) and the other end bay onshore being readied to be launched in the proper sequence. The exact timing of the launch is determined by how far along the men preparing the bridge are, and by when one of the boats can be released from the main bridge to go and pick up the next bay. There's the boat being released now. // There's the raft as completed so far. Off on the left you can see the boat which just left the raft picking up the last central bay.

In this scene you see the raft basically completed. We didn't show you the connection of the last central bay or the end bay because they're essentially done in the same manner you've already seen. // Here they're putting up the railing.

Next is a scene showing them attaching a boat to one side of the raft. A boat is lashed to each side to serve as a motor for propelling the raft. Once the raft is completed with railings up, boats attached, and all other safety devices ready, the bridge is ready to receive vehicles. // Here you see a front view of the raft ready to receive vehicles. // A man motions the vehicle aboard. Normally only two vehicles can be handled--either wheeled vehicles or track vehicles such as armored personnel carriers or tanks. // Once the vehicles are on board, the ramps that connect the raft with the shore are lifted, and the raft heads on to the other side. Incidentally, the boat that is from time to time seen floating in the background is the safety boat. One boat always operates as a safety boat and is not involved in the actual construction of the bridge. // Now the raft is being ferried across the river. At the front of the raft you will see a man standing with his arms outstretched, motioning to the two boats on the sides and, in effect, controlling the amount of power each boat provides. // When the raft arrives on the other shore, the ramps are lowered and the vehicles drive off. The raft then returns to the original shore and the process is repeated until the entire set of vehicles necessary are ferried across the river. //

Next you're going to see the disassembly procedure which is the whole process in reverse. The initial scene shows them disconnecting the latches and locks that hold the end bay to a central bay. // You can also see the boat being attached to the end bay. // When the latches are released, the end bay is essentially pulled away by the boat. It's then maneuvered over to the shore where one of the transporters is waiting for it. // Here you see the transporter backing up to the water. The bay transporters go to the river first, and the bays are pulled up. Then when all the bays are in, the boats are pulled in one by one. The safety boat remains in the river until everyone else is out of the river before being pulled in. Notice that hand signals are used to communicate with the boat and transporter operators, since the noise from the motors blocks the usual methods of communication. When everything is loaded, the transporters drive off.

(END OF TRAINING TAPE)

Obviously, both individual and team skills are required in the assembly of a raft or bridge. Individual skills refer to those activities that can be performed independently of other team members. Team skills refer to activities that must be performed in response to the actions of other team members, or that direct the actions of other team members. Certain individual skills must often be learned before team skills, and some team skills simply reflect additional demands--such as timing--that are placed upon the individual as he performs an individual skill.

Let me give you some examples of individual and team skills from building a ribbon bridge. Driving the power boat is an individual skill, but operating it in response to the platoon sargeant's commands turns it into a team skill. Using a t-wrench is an individual skill, but using it in response to other team members' actions as they connect the bays together is a team skill. Recognizing hand signals is an individual skill, but using hand signals to direct transporter operators in backing into the appropriate depth of water for launching a bay is a team skill, requiring the coordination of both the person giving the signals and the person operating the transporter. Directing the launching of boats and bays is also a team activity, since the supervisor must respond to, as well as direct the actions of other personnel.

At first glance, it may seem that the assembly and disassembly of a ribbon bridge is simply a serial task--that is, one in which a series of actions are performed in sequence. However, there are other forms of teamwork involved. Appropriate timing is critical to the effectiveness and speed of the operation. Since tasks are sometimes performed under conditions of restricted visibility or audibility, the use of hand signals becomes essential to coordinate activity.

Here are a few examples of bridge building activities that require various types and levels of teamwork, timing, or coordination:

1. Timing or sequencing the arrival of transporters, and the launching of the bays and boats.
2. Assisting the transporter operators in backing into the appropriate depth of water for the launching of bays and boats.
3. Using hand signals to guide the transporter drivers in operating levers for retrieving boats and bays.
4. Boat drivers aligning the bays behind the transporters in order to facilitate retrieval by the transporter section.
5. Boat drivers aligning the bays and ramps for connection.
6. Boat drivers responding to signals from the raft commander during the rafting operations.
7. Boat drivers maneuvering to prepare for immediate pick-up of bays upon launch.
8. Bridge specialists working simultaneously on different tasks and equipment in order to connect bays/ramps (e.g., using boat hooks, ropes, t-wrenches, wrecking bars, etc.).
9. Raising and lowering of the ramps.

INTRODUCTION TO MORTAR SQUADS

The job of the mortar squad is to provide combat support to the infantry ground troops. The mortar squad usually accompanies the infantry into combat but stays behind the battle line where they set up and fire the mortar. In the videotapes we will show you today, you will see two different size mortars being used--a smaller mortar known as an "81mm" (which is the diameter of the barrel) and a larger mortar called a "4.2" (four deuce) which has a longer firing range and greater accuracy.

Generally, the mortar squad fires on targets which are not directly observable--this is known as "indirect fire". This, of course, requires that they have accurate and precise information on the location of their target. This knowledge is provided by the Fire Direction Center (FDC). Here is the way it works: A forward observer (FO), who is actually in sight of the target or the enemy, relays target coordinates to the FDC, usually by radio. The FDC then computes the required elevation, deflection, and direction for setting up the mortar. The FDC transmits this information by telephone, radio, or voice to the mortar squad. The squad then sets up the mortar as directed and fires on command.

A typical mortar squad contains five men: a crew chief (or squad leader); a gunner; assistant gunner; ammunition bearer; and assistant ammunition bearer. Sometimes, as in some of the taped scenes you will see, the squad operates with one or two fewer men due to personnel shortages.

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NARRATIVE FOR TRAINING TAPE ON MORTAR SQUADS

In a moment you will see the training tape on mortar squads. Mortar squads can be either mounted or dismounted. In other words, they may be fired from the ground in a dismounted mode or from the vehicle itself in a mounted mode. What you'll be seeing in our tapes is a dismounted mode. Mortars can be transported either by armored personnel carrier (such as a tank) or, as we will see here, in a truck-like vehicle called a gamma goat.

(START TRAINING TAPE)

In the first scene you will see the gamma goat pulling up to its site. The mortar squad will then set up the gun and start unloading the rest of the materials which will include the ammunition and camouflage netting. There are four basic pieces of equipment: the circular object that sits on the ground called a baseplate; the long tube which is the gun itself; the bipod which is what the gun is supported on; and the sighting unit which is attached last and is used to actually sight the gun.

Assembly of the mortar normally requires the coordinated efforts of three men, and takes about 90 seconds if no problems occur. Two aiming stakes are placed on a line in front of the mortar and are used as a reference point for aiming the mortar. You will notice in the tapes that the gunner uses arm and hand signals to guide the man who is placing the stakes. The gunner also uses the sighting unit on the mortar in order to make the proper alignment. //

In this next scene you can see the gunner sighting through the boresight while the assistant gunner holds and moves the bipod, until the gun is set up at the proper angle. // Next you will see the gunner communicating with the man out in front with the sighting stakes; he communicates both verbally and with hand motions. //

(STOP TAPE BUT CONTINUE NARRATIVE)

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There are three pieces of information that a gunner must know before he can fire the mortar. One is the elevation; the second is the deflection, which is the extent to which the gun is aimed to the left or the right; and the third is the actual amount of the charge on the shell. The mortar shells come with a complete set of charges on them, consisting of small bags of powder at the base of the shell. The charge is adjusted by removing as many bags as necessary to come up with the proper charge. When you hear "Charge Three" called, it means remove all but three bags.

The process for firing begins when the Fire Direction Center (FDC) tells the mortar squad what the elevation, deflection, and charge should be. When the squad is ready, the gunner will announce it to the FDC. Then the FDC will either tell the squad leader to fire at his (the squad leader's) command, or will tell him to fire when they (the FDC) command it. When ready to fire, the assistant gunner or an ammunition bearer will take the shell and hold it in the end of the gun barrel without releasing it. He will then shout that the gun is "hanging"--that is, that the ammunition is hanging in the barrel ready to be fired. This is, in effect, a warning to everyone in the area that the gun is about to fire. On the command "Fire," the assistant gunner releases the shell. It slides down the barrel, where it strikes a pin; the pin sets off the charges, causing gases to form behind the shell and forcing it out the barrel.

In the scenes you'll see in a moment, we will show you the impact of the shell. Notice the delay in time involved from the firing to the actual impact. In this particular firing, the trajectory was fairly high and the distance about a mile. Also notice the delay from the visual impact to when you actually hear it. This situation is referred to as a "direct lay" because the mortar squad can actually see where they are firing. In many situations, however, the squad may be a fair distance behind the enemy line or on the other side of a mountain ridge where they are unable to see their target. This is known as an "indirect lay" situation. Information as to where the squad should be firing and their accuracy is provided by a forward observer who is communicating with the Fire Direction Center.

(RESUME TAPE)

In this scene you will see the mortar being fired for the purpose of laying (or setting) the baseplate. This is done in order to set the baseplate firmly into the ground. If you notice the gun carefully, you will see it recoil backward and you'll hear the baseplate slam into the ground. //

Here is a scene of a Fire Direction Center. Each mortar platoon consists of a Fire Direction Center and three or four mortar squads, called guns--the 1-gun, the 2-gun, the 3-gun, etc. Here we see the Fire Direction Center communicating with two of the squads, the number 2 squad and the number 3 squad. Communication occurs either by shouting, as seen here, or on a field telephone. //

This scene shows the squad preparing to fire again. In particular, notice the man on the left removing the charges from the 81 mm mortar shell; he's removing the excess bags, leaving only the bags necessary. This is the number 1 gun or the first squad. //

This scene shows the packing and unpacking of ammunition for the four deuce mortar. //

Here you see the firing of a four deuce mortar, which is somewhat larger than the 81 mm, and is a heavier gun. //

In this scene you see a squad member swabbing the bore. After a few rounds are fired, the barrel needs to be cleaned. //

Here you see the camouflage netting being put up. Whenever a squad is going to be in an area for awhile, they are required to erect some camouflage so that they will be less visible from the air and from troops moving within the area. Camouflage can be put up before the gun is fired, after the gun is fired, or whenever it is appropriate. //

(END OF TRAINING TAPE)

INTRODUCTION TO TEAMS AND TEAM FUNCTIONS

A team is a group of two or more individuals who are more or less aware of their existence as an identifiable group, and who are task-oriented in that they work in some way toward a specific and identifiable goal.

We are defining team functions as activities that basically serve to create an efficient and harmoniously operating team that can move toward the successful accomplishment of its goals. Team functions can be thought of as serving to organize and guide a team. In particular, they are designed to permit individuals performing their own tasks to operate in an integrated, coordinated manner with other team members.

A team may be thought of as a machine composed of a number of individual parts (the people), each performing a specific individual task. The team functions are designed to create a machine which operates in such a way that all of the individual parts operate harmoniously. This essentially comes about by individuals adjusting their activities, their speed, their focus, and when and where they do things, in order to fit the behavior of other people in the team.

A team function has the purpose of making the team operate in tune, instead of out of tune. It's kind of like the engine in your car. In order for the engine to run smoothly, each spark plug must fire at the proper time and in the proper sequence. If the timing and sequencing is not right, the engine runs very roughly; and if the timing becomes extremely bad, the engine may not run at all.

Team functions, then, have the goal of making the team run more efficiently, more harmoniously--like a team rather than a group of un-coordinated individuals.

Different team settings and different team goals may require different levels and different types of team functions. It is important to remember, therefore, that a particular team function does not have to appear in any given situation. Whether the function appears, and the extent to which it appears, depends on many other factors. You want to avoid thinking that "more is better," or that all functions must necessarily appear in every setting.

A problem with observing and rating functions is that they are, by their nature, not directly observable. They are really conceptual categories that we place observable events into. In order to know whether a behavior is serving a function, and what function it is serving, it is often necessary to know what the purpose of the behavior was. In other words, in order to classify a function you must make an interpretation of what the behavior is doing. Sometimes the same behavior can serve different functions. Similarly, different behaviors can, at various times, serve the same function. It is these types of difficulties that we are addressing in this study.

Our goal is to develop definitions and rating scales of functions that will allow people to fairly easily interpret what is going on in a team setting. We are still at an early stage of this process, so we are going to focus on only a few of the many possible functions. What we will do now is to provide you with definitions of the four team functions which we will be dealing with today. We will also give you examples of the functions from everyday life. After you have had a chance to look at this material and ask questions, we will show you the scales on which you will be rating the degree to which you saw the functions present in the videotapes.

(Pass out function definitions with examples.)

DEFINITIONS AND EXAMPLES OF FUNCTIONS

I. ORIENTATION

ORIENTATION concerns the extent to which orienting information is exchanged among team members. ORIENTATION provides facts. It does not command or initiate action. The information exchange may concern work, tasks, goals, procedures, task priorities, team members, equipment, the environment, or operational constraints. Feedback about previous performance can also qualify as ORIENTATION. ORIENTATION always occurs in the form of a communication. Orienting information differs from non-orienting information in that orienting information is always task related, while non-orienting information is extraneous or irrelevant to the task.

The extent to which teams exhibit the ORIENTATION function is related to the number of team members participating in the orientation, the length of the orientation, and the type of information exchanged.

Examples of Orienting Information:

1. "Waiter telling you the special of the day or how to order."
2. "We're almost out of gas."
3. "That was a nice job you did."
4. "Mission accomplished."

Non-Orienting Information:

1. "The sun is shining." (Spoken in the course of normal conversation, this would be non-orienting information. However, in another situation where the sun shining is critical to task performance--such as photographing into the sun--this could become orienting information. The context in which the statement is made, therefore, must be considered in distinguishing between orienting and non-orienting information.)

II. RESOURCE DISTRIBUTION/LOAD BALANCING

RESOURCE DISTRIBUTION or LOAD BALANCING concerns the degree to which team members adjust their activities to redistribute their personnel resources, equipment resources, or information resources. RESOURCE DISTRIBUTION or LOAD BALANCING occurs when team members recognize or respond to a perceived imbalance in their team resources.

RESOURCE DISTRIBUTION may occur as either a communication (e.g., a command or request for additional manpower or equipment) or a behavioral action. As a communication, it is distinguishable from ORIENTATION in that the communication contains a definite implication or request for action rather than being simply a statement of fact. When RESOURCE DISTRIBUTION occurs as a behavioral action, the adjustment is always a team effort rather than an individual effort--one man adjusting a piece of equipment on his own initiative, as a normal part of his job, does not constitute RESOURCE DISTRIBUTION.

The degree of RESOURCE DISTRIBUTION may be judged by noting the amount of communication regarding redistribution, the number of men or amount of equipment that is redistributed, the interchangeability or adaptability of the personnel or equipment that is redistributed, and how the resource allocation is initiated.

Communication Examples:

1. "Help me out!"
2. "Add more pressure on the corner."

Behavioral Examples:

1. Two firefighters coming over to help a third firefighter handling a hose with high pressure water.
2. Dishwasher comes out to bus tables during a busy period.

III. ACTIVITY PACING

ACTIVITY PACING is the extent to which a team changes the timing or speed of its tasks to facilitate the team mission. Speed and timing changes refer to the efforts of a team to increase, decrease, or maintain its pace on a task. These efforts can involve changing the pace of the entire team or adjusting the pace of part of the team in relation to other team activities.

ACTIVITY PACING may occur as either a behavioral action (e.g., the team slows down the pace of one task while increasing the speed of another) or a communication. The communication is often in the form of a command or request intended to initiate, direct, or control the timing or speed of events; it differs from ORIENTATION in that the communication contains a definite implication for action rather than being simply a statement of fact.

ACTIVITY PACING is distinguished from LOAD BALANCING in that it involves no change in personnel or equipment distribution; it is concerned simply with timing and speed.

Communication Examples:

1. "Hurry up!"
2. "Take your time."
3. "Start when I tell you to."

Behavioral Examples:

1. Sandwich maker in snack bar working faster when there's a long line at the counter.
2. Two firefighters start walking, then break into a run to come over to help a third man with a high pressure hose.
3. Any obvious change in the speed of an action in response to communication or change in the situation.

IV. RESPONSE COORDINATION

RESPONSE COORDINATION refers to the degree to which team members coordinate their responses in relation to a piece of equipment. For example, in maneuvering a heavy desk, team members can react to, compensate for, or adjust to the actions of others who are also maneuvering the desk. The degree of response coordination is thus related to the requirement for coordination, the complexity of the adjusting actions, and the extent to which the adjusting actions need to be ordered (occur simultaneously or in sequence) as opposed to occurring spontaneously without reference to order.

RESPONSE COORDINATION almost always occurs in the form of a visible behavior. Since RESOURCE DISTRIBUTION and ACTIVITY PACING activities may also involve some degree of RESPONSE COORDINATION, use the latter function only when RESOURCE DISTRIBUTION and ACTIVITY PACING are not present, or when they are clearly serving the more complex requirement of RESPONSE COORDINATION.

Examples of Response Coordination:

1. Two men chopping down a tree, alternating their axe chops into the same cut.
2. A "bucket brigade" at a fire where a bucket is passed along a chain of people to the fire.

EXAMPLE OF HOW THE SAME OR SIMILAR BEHAVIOR CAN SERVE DIFFERENT FUNCTIONS

The pit crew of a race car driver sends information to the driver by means of easily visible signals.

- One signal might tell the driver to increase or decrease his speed (Activity Pacing).
- One signal might tell him how many laps until the next pit stop, or the condition of a tire, etc. (Orientation).
- One signal might tell him to come in for a pit stop to adjust equipment or to change drivers (Load Balancing).
- The actual pit operations can simultaneously include changing the tires, gassing up, giving water and food to the driver, and performing other adjustments to the car (Response Coordination).

Although the pace of this activity is very high, once the action is underway, Activity Pacing is not an element unless there are changes or attempts at changes in the speed of operations.

IDENTIFYING FUNCTIONS BY PURPOSE/GOAL SERVED

In order to determine the presence of a particular function, it is often useful to ask what purpose or goal the behavior is serving. Remember that at least two individuals must be involved for a function to occur.

Orientation

The purpose here is to provide information which somehow relates to or maintains team activities either by (1) providing feedback about performance, or (2) telling other team members about the situation they must work in.

Resource Distribution/Load Balancing

The purpose here is to adjust resources--either equipment, materials, or manpower.

Activity Pacing

The purpose here is to alter or maintain the speed of an operation in order to (1) keep team members at the same approximate pace, or (2) to get team members into proper pace with respect to one another.

Response Coordination

The purpose here is to accomplish a task which could not be performed by one individual, in a coordinated, synchronous, harmonizing manner.

USING THE RATING SCALES

Now that we've discussed the definitions of the functions, I would like to show you the scales that were developed to measure each one.

(PASS OUT SCALES AND ANSWER SHEET)

You will notice that there are several scales for each function--four scales to measure Orientation, three to measure both Resource Distribution and Activity Pacing, and four for Response Coordination. The first scale for each function deals with the extent to which that function appeared in the videotaped segment. The remaining scales deal with other relevant dimensions of the function. Each scale ranges from 1 to 7, with one being the low end and seven the high end of the scale. Please take a few minutes now to read over and familiarize yourselves with the scales.

(ALLOW 5 MINUTES FOR SUBJECTS TO READ SCALES AND ASK QUESTIONS)

When you make your ratings, we would like you to select the scale value that corresponds to the response you want to make, and enter that value on your answer sheet. You can see that the answer sheet is divided into four vertical columns, one for each function. Within each column are the scales for that function. The videotape functions are numbered down the left side of the page. When you make your ratings for each segment, we want you to move horizontally across the page, filling in the boxes to the right of the appropriate segment number.

The procedure we will use will be as follows. We will show you each videotaped segment two times. You will then decide whether or not each function was present in the segment and enter "yes" or "no" in the appropriate box on the answer sheet. Please make these "yes/no" judgments first, before proceeding to the scales. If you have entered "no" for a particular function, there is nothing further you need to do--that is, you can ignore the scales for that particular function. If, however, you have answered "yes," you should go back and rate all the scales in that function.

We will now go through two trial or warm-up segments. You will see each segment twice. Then you will make your ratings--the "yes/no" ratings first and then the scale ratings. When you're through we'll discuss your answers and clarify any difficulties you may be having.

A few words about the segments themselves. The segments will vary somewhat in how easy it is to tell what is going on. In some of them, the functions are more obvious to recognize than in others. Don't be discouraged if you see a segment that is difficult for you to make a judgment on.

In most cases, the segments will have more than one function present, simply because the nature of team performance is such that more than one function occurs in order to accomplish a single task. However, we have tried to select segments in such a way that the number of functions present can potentially range from zero (no functions present at all) all the way up to four. If you feel that all four functions are there, you should fill out all the rating scales. If, however, you see a segment where you feel no function occurs, do not hesitate to indicate that on the answer sheet.

One word of caution. There is a temptation when viewing films such as these to make assumptions about what is taking place, either in the communications or in the actions. In making your judgments and ratings, I want to caution you about reading more into the data than is there. Judge only what you see or hear. If you cannot understand what the soldiers are saying, do not allow it to play a part in your ratings. Be very conservative in any interpretations that you make.

O.k., if you have no further questions, I will show you the first of the two sample segments.

(SHOW FIRST SEGMENT. ALLOW TIME FOR RATINGS; DISCUSS ANSWERS. REPEAT PROCEDURE FOR SECOND SEGMENT.)

We will now proceed to view the 13 remaining test segments. Prior to each one, I will make a brief introductory statement to prepare you for what you will be seeing. You will then see each segment twice, as you did before.

TEAM FUNCTION RATING SCALES

I. ORIENTATION

Was the ORIENTATION function present in the videotaped segment you just viewed?

YES _____ NO _____

If "yes," rate the following four ORIENTATION scales (IA, IB, IC, ID). If "no," go on to function II.

IA. Rate the extent to which you perceived the ORIENTATION function occurring in the videotaped segment.

7	The team activities were exclusively concerned with orientation.
6	
5	
4	The team activities were moderately concerned with orientation.
3	
2	
1	The team activities included a small amount of orientation.

I. ORIENTATION

(Number of Personnel)

IB. Rate the extent to which you perceived the ORIENTATION function occurring in the videotaped segment by indicating the number of team personnel involved in orientation. (Caution: Remember that the scale values represent levels, not actual numbers of men involved.)

7 — The full complement of men was involved in the orienting information exchange.
6
5
4 — Approximately half of the team was involved in the orienting information exchange.
3
2
1 — The orienting information exchange occurred primarily between two team members.

I. ORIENTATION

(Duration of Orientation)

IC. Rate the extent to which you perceived the ORIENTATION function occurring in the videotaped segment by indicating the duration of time devoted to orientation.

7	The entire duration of videotaped activity appeared devoted to orientation.
6	
5	
4	Approximately half of the videotaped activity appeared devoted to orientation.
3	
2	
1	A very small amount of videotaped activity appeared related to orientation.

I. ORIENTATION

(Types of Orientation)

ID. Rate the extent to which you perceived the ORIENTATION function occurring in the videotaped segment by indicating the number of types of information exchanged. Types of information may include reference to tasks, goals, procedures, task priorities, team members, equipment, environment, or operational constraints, as well as feedback.

7	The information exchanged included all types of information.
6	
5	
4	The information exchanged concerned several types of information.
3	
2	
1	The information exchanged basically concerned one type of information.

II. RESOURCE DISTRIBUTION/LOAD BALANCING

Was the RESOURCE DISTRIBUTION/LOAD BALANCING function present in the videotaped segment you just viewed?

YES ______ NO ______

If "yes," rate the following three RESOURCE DISTRIBUTION/LOAD BALANCING scales (IIA, IIB, IIC). If "no," go on to function III.

IIA. Rate the extent to which you perceived the RESOURCE DISTRIBUTION/LOAD BALANCING function occurring in the videotaped segment.

7	The team activities were exclusively concerned with resource adjustment/load balancing.
6	
5	
4	The team activities were moderately concerned with resource adjustment/load balancing.
3	
2	
1	The team activities were only slightly concerned with resource adjustment/load balancing.

II. RESOURCE DISTRIBUTION/LOAD BALANCING

(Number of Personnel/Amount of Equipment)

IIB. Rate the extent to which you perceived RESOURCE DISTRIBUTION/LOAD BALANCING by indicating the number of personnel/amount of equipment included in the resource adjustment.

7	All of the team personnel shifted their efforts from one task to another to further the mission; or all of the team's equipment was redistributed for the team effort.
6	
5	
4	Approximately half of the men (or equipment) was redistributed for the team effort.
3	
2	
1	Almost no one shifted his efforts to respond to a local imbalance; or only a minor piece of equipment needed to be redistributed for the team effort.

II. RESOURCE DISTRIBUTION/LOAD BALANCING

(Interchangeability of Men or Equipment)

IIC. Rate the extent to which you perceived RESOURCE DISTRIBUTION/LOAD BALANCING by indicating the degree to which persons or supplies were interchangeable and did not disrupt the team effort.

7	The team effort proceeded undisrupted when resources were reallocated. (Resource adjustment was a normal part of the task requirement.)
6	
5	
4	The team effort underwent moderate disruption when resources were reallocated.
3	
2	
1	Team activities were severely disrupted when resources were reallocated.

III. ACTIVITY PACING

Was the ACTIVITY PACING function present in the videotaped segment you just viewed?

YES ______ NO ______

If "yes," rate the following three ACTIVITY PACING scales (IIIA, IIIB, IIIC). If "no," go on to function IV.

IIIA. Rate the extent to which you perceived the ACTIVITY PACING function occurring in the videotaped segment.

7 The team activities were characterized by a great deal of activity pacing.

6

5

4 The team activities were characterized by a moderate amount of activity pacing.

3

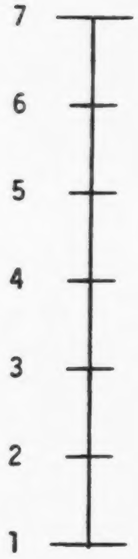
2

1 The team activities were characterized by low levels of activity pacing.

III. ACTIVITY PACING

(Communications about Speed/Timing Changes)

IIIB. Rate the extent to which you perceived the ACTIVITY PACING function occurring in the videotaped segment by indicating the number of communications about starting or stopping activities, or about changing the speed of activities.



7 There were many communications regarding speed changes, or starting or stopping activities.

4 There were several communications regarding speed changes, or beginning or stopping activities.

1 There were no communications regarding speed changes, or starting or stopping activities.

III. ACTIVITY PACING

(Visible Speed/Timing Changes)

IIIC. Rate the extent to which you perceived the ACTIVITY PACING function occurring in the videotaped segment by indicating the extent to which there were visible speed or changes exhibited by the team.

7 There was a great deal of change in the speed of the activities.

6

5

4 There was a moderate amount of change in the speed of the activities.

3

2

1 There was almost no change in the speed of activities.

IV. RESPONSE COORDINATION

Was the RESPONSE COORDINATION function present in the videotaped segment you just viewed?

YES ______ NO ______

If "yes," rate the following four RESPONSE COORDINATION scales (IVA, IVB, IVC, IVD). If "no," you may stop and wait for the next videotaped segment.

IVA. Rate the extent to which you perceived the RESPONSE COORDINATION function occurring in the videotaped segment.

7	The team activities demonstrated a high degree of response coordination.
6	
5	
4	The team activities demonstrated a moderate degree of response coordination.
3	
2	
1	The team activities demonstrated a low degree of response coordination.

IV. RESPONSE COORDINATION

(Involvement of Team)

IVB. Rate the extent to which you perceived the RESPONSE COORDINATION function occurring in the videotaped segment by indicating the degree to which the whole team was involved in the coordination effort.

7	The entire team was involved in the coordination activities.
6	
5	
4	About one-half of the team was involved in the coordination activities.
3	
2	
1	Only a small part of the team was involved in the coordination of the activities.

IV. RESPONSE COORDINATION

(Complexity of Coordination)

IVC. Rate the extent to which you perceived the RESPONSE COORDINATION function occurring in the videotaped segment by indicating the degree to which the team coordination efforts occurred in a complex and detailed manner, requiring careful and continuous monitoring of other team member activities.

7 — The response coordination involved very complex and detailed adjustment and sequencing of behavior.

6 —

5 —

4 — The response coordination involved moderately complex adjustments and sequences of behavior.

3 —

2 —

1 — The response coordination involved simple adjustments and sequencing of behavior.

IV. RESPONSE COORDINATION

(Similarity/Dissimilarity of Activity)

IVD. Rate the extent to which you perceived RESPONSE COORDINATION occurring in the videotaped segment by including the degree to which the response coordination involved similar activities from team members or dissimilar activities.

7	The team activities demonstrated considerable variety in their coordination actions.
6	
5	
4	The team activities demonstrated moderate variety in their coordinating actions.
3	
2	
1	The team activities demonstrated little variety in their coordination actions (all team members were performing similar coordinating actions).

SUBJECT: ______________________________

ANSWER SHEET

TAPE #	I. ORIENTATION						II. RESOURCE DISTRIBUTION					III. ACTIVITY PACING					IV. RESPONSE COORDINATION					
	NO	YES	IA	IB	IC	ID	NO	YES	IIA	IIB	IIC	NO	YES	IIIA	IIIB	IIIC	NO	YES	IVA	IVB	IVC	IVD
1																						
2																						
3																						
4																						
5																						
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INTRODUCTION TO VIGNETTES

The segments you will see vary somewhat in how easy it is to tell what is going on. In some of them, the functions are more obvious than in others. So don't be discouraged if you see a segment that is difficult for you to make a judgment on. In most cases, the vignettes will have more than one function present, simply because the nature of team performance is such that more than one function occurs in order to accomplish a single task. However, we have tried to select the vignettes in such a way that the number of functions present can potentially range from zero (no functions present at all) all the way up to all four functions being present. So if you feel that all four functions were there, then you will fill out all the rating scales. But if you see a segment where you feel no function has appeared, then you should not hesitate to indicate that on the rating scales.

We will begin by showing you a sample vignette and ask you to fill out the scales on a warm-up basis to make sure that you understand how to use the scales. Then we will show each vignette twice, introducing each with a few words to explain the situation. You will see it once, then you will see it again, and then you will fill out the rating scales. After you are through observing the videotapes of team behaviors, we will ask you to briefly describe the processes you went through in making those ratings, including whether or not you had any difficulties or other problems.

INTRODUCTORY STATEMENTS FOR THE STIMULUS TAPES*

1. Setting up camouflage. This scene shows members of the mortar squad setting up the camouflage netting behind the mortar. Keep in mind that the full team includes five members. You should ignore the noise and voices in the background; they are primarily coming from other mortar squads getting themselves set up.

2. Swabbing the bore. In this scene the gunner and assistant gunner are swabbing the bore. Toward the end of the scene, you will hear someone shout "two gun up"; that is the Fire Direction Center (FDC) telling them to get ready to fire.

3. Preparing for action. This scene shows the men setting up the guns.

4. Firing one round. This scene shows the men going through the sequence necessary to fire one round. The expression "gun up" means that the mortar is aimed properly and ready to fire. The expression "ammo up" means that the ammunition has been properly charged and is available for firing. "Two gun hanging" means that the gunner is holding the ammunition in the mouth of the barrel of the mortar.

5. Communication to man with aiming stake. In this scene the gunner is signaling to a man about 100 yards out in front of the gun with an aiming stake. Since this is a training exercise, the man to the left of the gunner is guiding the gunner through his actions. For the purposes of this segment, consider the man that you cannot see with the aiming stake as a member of the team.

6. Working with ammunition crates. In this scene you will see the men unpacking ammunition as well as putting ammunition crates back together and stacking them.

---

*Segments 1 and 2 were used as trial segments. Segments 3-15 were the actual test segments.

7. Firing three rounds with safety violation. In this scene you will see three rounds fired. After the firing, the section chief will talk to the assistant gunner about a safety violation. The assistant gunner has used only one hand to hang the ammunition rather than two hands as required.

8. Firing three rounds (4.2). This scene shows a four-deuce mortar squad firing three rounds. In the distance you will hear the FDC calling out information. You will also hear shouts from the number three gun which is located next to the gun you are looking at. You need to ignore these. Assume that the four men visible constitute the entire team.

9. Lashing the boat to the raft. In this scene you will see preparations to lash one of the boats to the raft so that the boat can act as an engine for the raft. Assume that all of the personnel on the raft and in the boat are members of the team. Ignore the people standing on the shore.

10. Trucks coming aboard the raft. In this scene you will see trucks coming aboard the raft. Assume that the truck drivers are part of the team and that members on the raft and in the boat are also part of the team.

11. Lifting the ramps. This scene shows the men lifting the ramps in preparation for leaving the shore.

12. Lowering the ramps. This scene shows the men lowering the ramps in preparation for off loading the trucks.

13. Transfering equipment from boat to bay. This scene shows the men transfering various pieces of equipment from the boat to the bay, as well as preliminary preparations of the bay for receiving the next bay.

14. Power boat tapping bay. This scene shows one of the boats coming around to the end of the bay, tapping it several times, and then shoving it in a continuous motion. This action was requested by the team leader on board the raft because they were having difficulty latching the last end bay to the rest of the raft.

15. Attaching bay to transporter for retrieval. This scene shows the team moving the bay into position to be pulled back up onto the transporter. Assume that the boat driver and the truck driver, as well as the man standing on the truck and on the bay, are all members of the team.

RAW DATA LISTING

Format: (F2.0, 2F1.0, F2.0, 1X, 5F1.0, 1X, 4F1.0, 1X, 4F1.0, 1X, 5F1.0)

Variables

1. Subject Number
2. Testing Day (1, 2, or 3)
3. A.M. (1) or P.M. (2)
4. Videotape Segment Number

Orientation Ratings

5. Present (1)/Absent (0)
6. General
7. Number of Personnel
8. Duration
9. Types

Resource Distribution Ratings

10. Present (1)/Absent (0)
11. General
12. Personnel/Equipment
13. Interchangeability

Activity Pacing Ratings

14. Present (1)/Absent (0)
15. General
16. Communications
17. Visibility

Response Coordination Ratings

18. Present (1)/Absent (0)
19. General
20. Team Involvement
21. Complexity
22. Similarity/Dissimilarity

Raw Data Listing (continued)

```
011101 13331 0000 1655 14422
011102 00000 0000 1222 12621
011103 12121 0000 0000 14544
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011106 00000 0000 0000 11111
011107 11111 0000 0000 12222
011108 00000 1226 0000 14523
011109 00000 1537 0000 16543
011110 00000 0000 0000 12111
011111 00000 0000 0000 13721
011112 00000 0000 0000 13511
011113 00000 0000 0000 00000
011114 00000 1427 0000 14433
011115 00000 0000 0000 16744
021101 14447 1444 1411 17414
021102 17141 1117 1144 14114
021103 00000 1744 1774 11117
021104 14414 1777 1441 14744
021105 00000 1747 1771 11411
021106 00000 0000 1111 11711
021107 14411 0000 1441 11711
021108 11777 1777 1111 14717
021109 00000 1747 1741 14711
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021111 00000 1717 -1441 1171+
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021115 00000 1747 0000 14711
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031202 11311 0000 1126 14212
031203 13242 1117 1773 16645
031204 16444 1117 0000 12214
031205 00000 1647 0000 17426
031206 00000 0000 0000 00000
031207 15141 1424 0000 17424
031208 16433 0000 0000 11314
031209 00000 1127 0000 12514
031210 00000 0000 0000 16246
031211 00000 0000 0000 17211
031212 00000 0000 0000 17411
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031215 00000 0000 0000 13423
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041202
041203 11111 1121 1333 17676
041204 15334 1233 0000 17776
041205 00000 1641 0000 14654
041206 00000 0000 0000 00000
041207 14331 0000 0000 16754
041208 16662 0000 0000 17766
041209 00000 1246 0000 16753
041210 00000 0000 0000 15744
041211 16662 0000 0000 14422
041212 11611 0000 0000 11322
041213 00000 0000 0000 11111
041214 00000 1771 0000 13433
041215 00000 0000 0000 13363
051201 00000 1426 1425 16522
051202 11111 0000 1676 11111
051203 00000 0000 1653 16556
051204 00000 0000 0000 16466
051205 11111 1254 0000 14234
051206 00000 0000 0000 00000
051207 15432 0000 0000 17533
051208 13441 1546 0000 14333
051209 00000 1324 0000 14422
051210 00000 0000 0000 12112
051211 00000 0000 0000 14211
051212 00000 1443 0000 15331
051213 00000 1435 0000 00000
051214 00000 0000 0000 11132
051215 00000 0000 1443 14331
061201 11111 1321 0000 12546
061202 00000 0000 1334 11115
061203 00000 1444 1654 16556
061204 16466 1433 0000 12223
061205 00000 1755 0000 14562
061206 00000 0000 0000 16622
061207 11141 0000 0000 12222
061208 00000 1542 0000 15435
061209 00000 1645 0000 16664
061210 00000 1666 0000 16252
061211 00000 0000 0000 16211
061212 00000 1336 0000 16511
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061214 12222 0000 0000 14242
061215 00000 1766 0000 16566
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072102 00000 1222 1333 14644
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Raw Data Listing (continued)

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072108 00000 0000 0000 14643
072109 00000 1322 0000 16655
072110 13221 0000 0000 13332
072111 00000 1322 0000 15741
072112 12721 0000 0000 15732
072113 00000 1336 1323 16666
072114 00000 1645 0000 13333
072115 00000 1556 0000 15556
082101 13434 1564 1454 14444
082102 13322 1234 1435 14112
082103 00000 1526 1777 16756
082104 14436 1436 0000 15645
082105 00000 1655 0000 15555
082106 00000 1335 0000 15511
082107 15451 0000 0000 14531
082108 14436 1236 0000 16544
082109 00000 1437 0000 15713
082110 00000 0000 0000 17764
082111 00000 1547 0000 17433
082112 00000 0000 1444 17411
082113 00000 1544 0000 14737
082114 00000 1755 0000 15652
082115 00000 1546 0000 15665
092201 00000 1346 1432 14542
092202 00000 0000 1324 13411
092203 00000 1336 1655 15544
092204 15633 1435 0000 15644
092205 13232 1626 0000 15434
092206 00000 1346 0000 12322
092207 12623 1342 0000 16753
092208 15763 1336 1433 15533
092209 00000 1336 0000 15643
092210 00000 0000 1133 13243
092211 00000 0000 0000 15712
092212 00000 1236 1443 16621
092213 00000 1336 0000 12324
092214 00000 1425 0000 13222
092215 00000 1226 1132 15443
102201 00000 1444 0000 16534
102202 12122 0000 1334 13326
102203 13232 1235 1433 17767
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102206 00000 1435 0000 12321
102207 13231 0000 1213 15634
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102209 00000 1325 0000 14536
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102211 00000 0000 0000 17711
102212 00000 1226 0000 17711
102213 00000 1567 0000 00000
102214 00000 0000 0000 11511
102215 00000 1126 0000 14636
112201 11111 1454 0000 17766
112202 00000 0000 1444 17412
112203 14744 1567 1456 17777
112204 16766 1777 1555 17777
112205 15652 1717 0000 14523
112206 00000 1777 0000 00000
112207 13741 1537 1424 14444
112208 14746 1757 1756 17777
112209 00000 1767 1546 17445
112210 16442 1747 1677 17234
112211 00000 1757 1313 17711
112212 11111 1727 1446 17711
112213 00000 1777 1717 00000
112214 12111 1716 1244 12223
112215 13443 1757 1213 14435
122201 00000 1554 1544 14513
122202 14134 1216 1425 12222
122203 00000 1573 1765 15755
122204 11411 1556 1434 13436
122205 00000 1655 1122 12422
122206 00000 1656 1233 14622
122207 14541 1564 1123 15743
122208 14623 1627 1324 15543
122209 00000 1657 1566 16544
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122211 00000 1334 1223 15545
122212 12732 1322 1442 16532
122213 00000 1666 1565 15444
122214 12231 1353 1344 14333
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133104 12423 0000 1313 14424
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Raw Data Listing (continued)

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133112 00000 1467 0000 00000
133113 00000 1665 0000 16645
133114 00000 1625 0000 00000
133115 00000 0000 0000 13633
143101 00000 1237 0000 15312
143102 00000 0000 1554 16244
143103 00000 1546 1445 16343
143104 14324 1554 0000 16544
143105 00000 1725 0000 16235
143106 00000 0000 0000 13521
143107 00000 0000 0000 15554
143108 15434 0000 1222 16745
143109 00000 0000 0000 15744
143110 00000 0000 0000 14323
143111 00000 1664 0000 17622
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143113 00000 0000 0000 14545
143114 00000 1534 0000 15443
143115 00000 1563 0000 16644
153101 00000 0000 0000 15424
153102 00000 0000 1323 14436
153103 00000 1127 1665 16555
153104 15254 0000 0000 15767
153105 00000 0000 0000 16664
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153108 15444 0000 0000 16757
153109 00000 0000 0000 15524
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153111 00000 0000 0000 16714
153112 00000 0000 0000 16712
153113 00000 0000 0000 13722
153114 11111 1426 0000 16766
153115 00000 0000 0000 16767
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163103 00000 0000 1223 17644
163104 00000 1576 1445 16645
163105 00000 0000 1145 17644
163106 00000 0000 0000 15714
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163109 00000 1122 0000 15644
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163111 00000 0000 0000 14411
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163114 00000 0000 0000 12711
163115 00000 0000 1133 14623
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173203 00000 1574 1552 16666
173204 12122 1666 0000 13456
173205 00000 1755 0000 13625
173206 00000 0000 0000 12612
173207 13222 1333 1455 15534
173208 11112 1456 1415 16556
173209 00000 1536 1112 14627
173210 00000 1756 1515 11315
173211 12721 1777 0000 14711
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173215 00000 1662 0000 15554
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183214 00000 1626 0000 15234
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193201 00000 1327 0000 16312
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Raw Data Listing (continued)

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193213 00000 0000 0000 00000
193214 00000 0000 0000 11211
193215 00000 0000 0000 13233
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